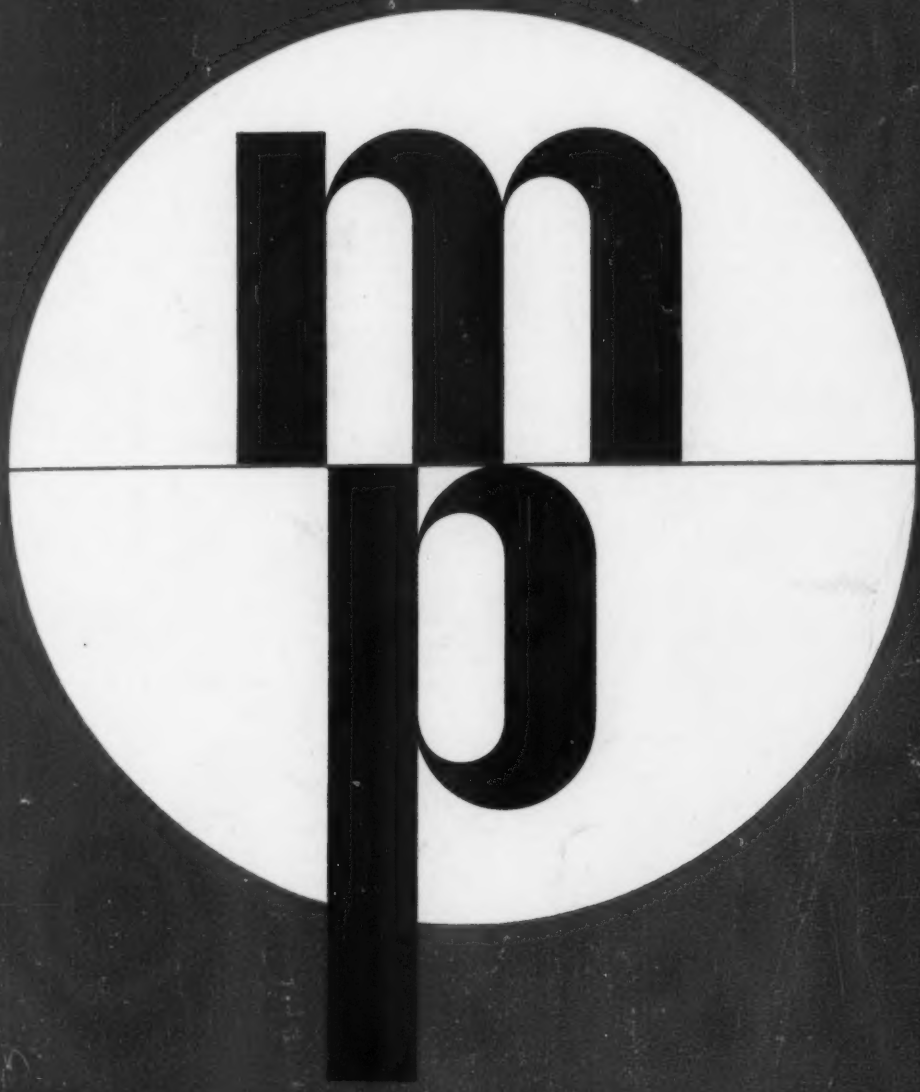
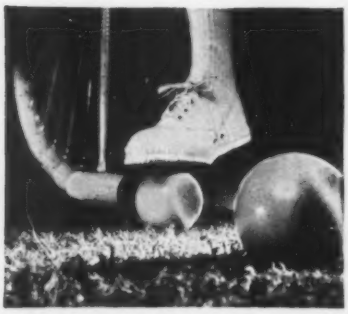
MODERN PLASTICS



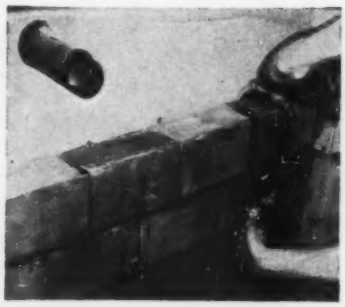
page 103 **Everyone can find many uses for plastisols—here's how and why**

page 153 **Meet a new thermoplastic with unique properties and great promise**

for these **important properties** in your products . . .

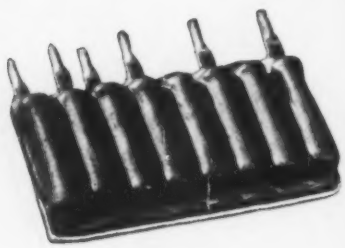


Bonding Strength of these resins is dramatically evident in chip-proof, split-proof molded products and board made from wood particles.



Acid Resistance makes Durez resin useful as base in cements and mortars for bonding acid-proof brick in tanks, vats and floors.

Heat Resistance of resins gives foundry shell molds hot strength sufficient for metal casting production.



Insulating Properties of resins are used in dip coating compounds to insure uniform resistance of small radio and TV components.

Compatibility of resin with nitrile rubber makes it a useful modifier. In GRS stocks it increases hardness and resistance to wear.

Wear Resistance of bonding resin prolongs useful life of brake materials. Resins also add resistance to hear, water and oil.

turn to **DUREZ** phenolic **RESINS**

FOR DESIGNERS AND ENGINEERS seeking a bonding, impregnating, or coating agent with the ability to impart important end-product characteristics, Durez phenolic resins have many interesting possibilities.

THESE SAMPLES ILLUSTRATE some of the widely varied roles they are now playing in industry. The mechanical strength of these resins and their hardness when cured are combined with remarkable properties of resistance to chemical reaction and to heat. Dielectric strength and power factor qualify them for numerous electrical applications.

THE MOST DESIRABLE type and form of Durez resin for any purpose is determined by the processes which w'll be used, and the available conditions of temperature and pressure in addition to the end-product properties required.

OUR COMPREHENSIVE BOOKLET on the performance of phenolic resins in industry has recently been published in a new edition. For a free copy, please write on your letterhead for "Durez Industrial Resins."

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Hospitals and physicians now *save* by *throwing away!*

THANKS TO *Catalin* STYRENE

Tough and economical . . . CATALIN STYRENE, *the gem of plastics,* was the logical choice to mold the barrel and plunger of the Admiral SDS Sterile Disposable Syringe.*

New and welcome is the relief this modern medical convenience affords to busy nurses and hospital staffs. Saved is the drudgery and expense of disassembling, sterilizing, sharpening and reassembling the old-type reusable syringe.

Laboratory-sterile and factory-sharp in its transparent envelope, each Admiral SDS is kept indefinitely in handy storage, used at an instant's notice and then dropped into the trash can . . . along with all the old headaches of reconditioning and maintenance.

In many other manufacturing applications, too, CATALIN STYRENE gives a booster shot of convenience and economy. For durable wares—as well as for a disposable item like this one—it offers the sterling qualities of ruggedness, handsome appearance and ready moldability.

**Product of Admiral Corporation, Hospital Service Division, West Chicago, Ill.*

CATALIN CORPORATION OF AMERICA
ONE PARK AVENUE • NEW YORK 16, N. Y.

Catalin

Catalin plastics include polystyrene, polyethylene and nylon molding and extrusion compounds.

Catalin produces a wide range of urea, phenolic, cresylic, resorcinol and melamine resin formulations.

Catalin chemical products include antioxidants, oil additives, bacteriostats, alkylation products, etc.

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Another new development using

B.F.Goodrich Chemical *raw materials*

Potato harvester made by The Dahlman Manufacturing Company, Braham, Minn., has conveyor bars coated with vinyl foam of Geon produced by Bradley & Vrooman Company, Chicago, Illinois.

NO MASHED POTATOES

with Geon-coated conveyors

POTATOES get no mashing bumps from this speedy harvester, thanks to Geon polyvinyl materials. Chain conveyors, wheel elevator and buckets, and clod eliminator are all coated with a foaming type plastisol with an extremely tough skin—give perishables a bruise-free ride and help cushion shock at transfer points.

The Geon-based coating is ideally suited for this unique use. It is springy, durable and abrasion-resistant. It holds up to moisture, withstands mildew and resists fire.

Geon is a versatile plastic raw material for a broad range of applications. As foam, it serves as safety padding and cushioning. Rigid Geon compounds make corrosion-resistant piping and duct. Wall covering and high dielectric insulation for wire and cable are made of flexible Geon. Geon coatings are widely used for packaging materials, metals and textiles.

Get technical information on Geon polyvinyl materials. Write Dept. FQ-12, B. F. Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

Geon
Polyvinyl Materials

B.F.Goodrich Chemical Company
a division of The B.F.Goodrich Company

B.F.Goodrich GEON polyvinyl materials • HYCAR American rubber and latex • GOOD-RITE chemicals and plasticizers • HARMON colors

New nylon gun body is made in one piece, integrating three former parts in one. It weighs only 5 ounces—is easy to handle, easy to clean. Flashing, buffing and plating are eliminated because the smooth, black finish is *in* the nylon.

Chicago Molded helps develop nylon body for new

Sears-Roebuck paint spray gun...

- that's 66% lighter
- practically indestructible
- tighter sealing than die cast aluminum
- eliminates several machining, polishing and plating operations

This new spray gun will help the do-it-yourselfer to do a more professional job. The entire unit—made by the Electric Sprayit Division of Thomas Industries Inc.—offers home hobbyists new ease of cleaning, ease of handling and greater durability. Models of this new spray gun will be offered by Sears-Roebuck under the Craftsman label, and by independent stores under the Sprayit name.

The behind-the-scenes story is the new application of nylon (Du Pont's Zytel) developed after nearly two years of cooperative research by engineers of Chicago Molded, Electric Sprayit and Sears. By injection molding the entire gun mechanism in a single cavity, several machining, polishing, buffing and plating operations normally required for metal guns have been eliminated. At the same time, the finished product is two-thirds lighter—an important fatigue factor in spraying. And the nylon-to-metal screw threadings make tight seals, guard against leakage of compressed air. Furthermore, nylon is not affected by common solvents, greases, alkalis or oils, and dried paint does not tend to stick to its smooth, lustrous surface.

Whatever your new product needs, you'll find it pays to call in Chicago Molded. CMPC engineers keep abreast of developments in all plastics to help you make your product more saleable, yet less costly. *That's why 66% of our business comes from firms we've served for over 20 years.*

Write today for a free subscription to Plastics Progress, Chicago Molded's data-packed magazine on up-to-date developments in plastics.

Chicago Molded Products Corporation
1046 North Kolmar Avenue, Chicago 51, Illinois

Editorial

A report and a promise

As a year of great activity in plastics comes to a close, we feel it fitting to report to our readers on our activities in their behalf.

In 1957 the editors of MODERN PLASTICS presented 1216 pages of reading matter which was background for 2536 pages of advertising.

On matters of general interest to end-user readers the General Section carried 558 pages of information.

The Plastics Engineering Section, including discussion and illustration of new equipment, ran 160 pages over the year.

The Technical Section, embracing detailed papers on new phases of plastics technology used 162 pages.

The Plastiscope, containing the latest information on materials developments, trends in the industry, and news, ran 210 pages. Finally, Books and Booklets, Digest, Patents, and back of book features accounted for 126 pages.

The 1216 pages of reading matter in MODERN PLASTICS in 1957 represented over 80,000 miles of travel by its editors, 72 man-days at conventions, around 700 field interviews, and vast quantities of correspondence. The editors of MODERN PLASTICS spoke from 9 platforms, sat in at 22 industrial committee meetings. If we have served you well this year you will be happy to know that we are geared up for even better service to our readers in 1958. Our promise is this:

a) Even more dramatic presentation, including full-color illustrated covers beginning with the January issue; b) tighter editing and more use of charted reference material; c) more travelling, more field contacts, particularly with end-user readers; d) the same dedicated devotion to the purposes of plastics and to the interests of our readers that has always been the mark of MODERN PLASTICS Magazine.

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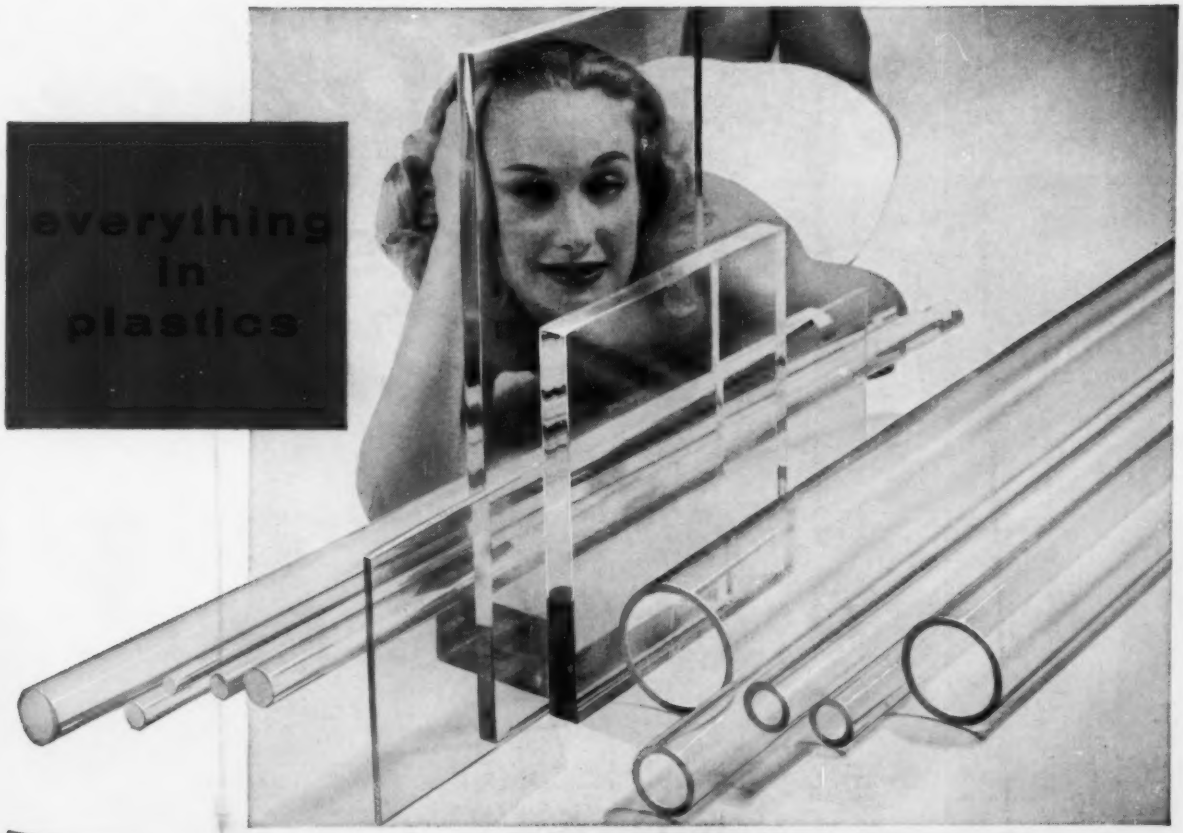

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Celanese

OFFERS ALL PACKAGING

The unique properties of Fortiflex-A—particularly its toughness and resistance to chemical attack at elevated temperatures — offer new opportunities in the packaging of food, drugs, cosmetics and chemicals. Applications for Fortiflex-A include: thin wall bottles and vessels . . . light weight, disposable containers vacuum formed from sheet stock . . . sterilizable films and coatings.

Injection Molded Bottles and Containers

Fortiflex-A molds easily in existing polyethylene molds. However, its great rigidity and toughness make possible impressive economies in wall thickness when molds are specially built. Savings in material weight over conventional polyethylene average as high as 40%. The exceptional thermal resistance of Fortiflex-A permits the packaging of hot liquids and semi-solids at temperatures up to 225° F., as well as surgical equipment that requires post-packing sterilization. Its chemical and permeation resistance recommend it as a replacement for expensive materials in the packaging of highly corrosive chemicals.

Blown Bottles and Containers

Lightness with strength and rigidity are obtainable in blow moldings of Fortiflex-A. This molding technique offers valuable economies in material weight, a faster rate of production and real savings in shipping costs of packaged merchandise. When protection against light is required, dense pigment can be incorporated so as to give complete opacity. Blow molded bottles of Fortiflex-A can be produced at only ⅛ the weight of glass and ¼ the weight of metal.

Supported and Unsupported Films

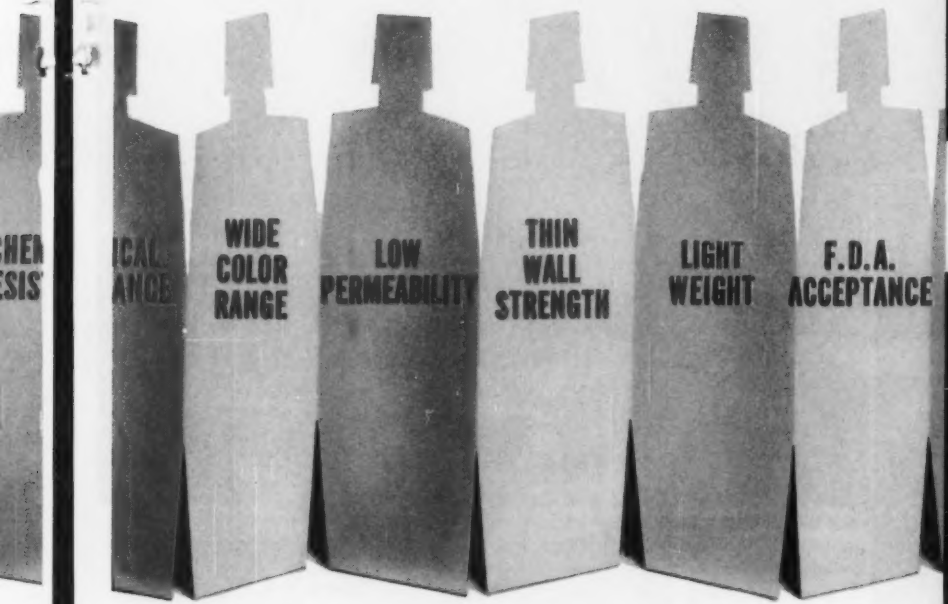
As a potential material for supported and unsupported films, the packaging advantages of Celanese Fortiflex-A open up a new range of opportunities in food, medical and industrial packaging. Films of Celanese Fortiflex-A will make possible sterilization after packaging. They exhibit great toughness and durability, virtually zero vapor transmission, and good transparency. The characteristic rigidity of Celanese Fortiflex-A will produce a film easily handled on standard automatic packaging machinery.

FORTIFLEX-A

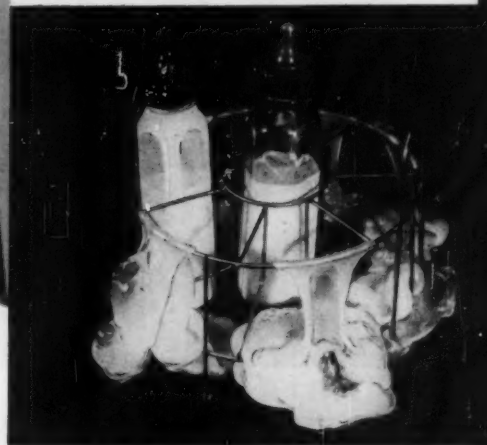
A POLYOLEFIN PLASTIC

2 REASONS WHY FORTIFLEX-A BELONGS IN YOUR PACKAGING PROGRAM

THESE ADVANTAGES



STRENGTH AND RIGIDITY IN THIN WALLS! Camera time-exposure dramatizes toughness and rigidity of Fortiflex-A. Liquid filled, blown bottle is dropped from approximately shoulder height onto hard surface. Close-up, taken after test, shows bottle to be undamaged.



HEAT RESISTANCE! Laboratory test displays the superior heat resistance of Celanese Fortiflex-A. Bottles molded of Celanese Fortiflex-A, glass and ordinary polyethylene were sterilized for 15 minutes at 15psi, 250°F. Only the glass bottle and Fortiflex-A bottle withstood the sterilization temperature. The ordinary polyethylene bottles were reduced to an amorphous state.

Vacuum Forming

Extruded sheeting of Celanese Fortiflex-A exhibits excellent vacuum forming characteristics. Deep drawing qualities and minimum post-mold shrinkage give advantages in this application. The great toughness and durability of extruded sheeting of Celanese Fortiflex-A are factors that will contribute to more efficient, more economical packaging. Extruded sheeting of Celanese Fortiflex-A is now available from suppliers. The Celanese Sales Development Department will be glad to supply names and addresses.

For complete information about Celanese Fortiflex-A—production-run quantities, test quantities, prices—write Sales Development Department, Celanese Corporation of America, Plastics Division, Dept. 101-L, 290 Ferry Street, Newark 5, N. J.

Celanese® Fortiflex®

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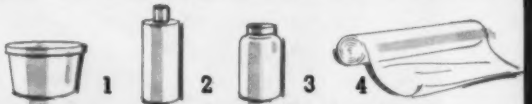


Sales Development Department, Celanese Corporation of America, Dept. 101-L, Plastics Division, 290 Ferry Street, Newark 5, N. J.

☐ **I am interested in more information about Fortiflex-A for possible application as_____(enter number).**

☐ **Have a representative call on me.**

Name _____

Title _____

Company _____

Address _____

City _____ **State** _____

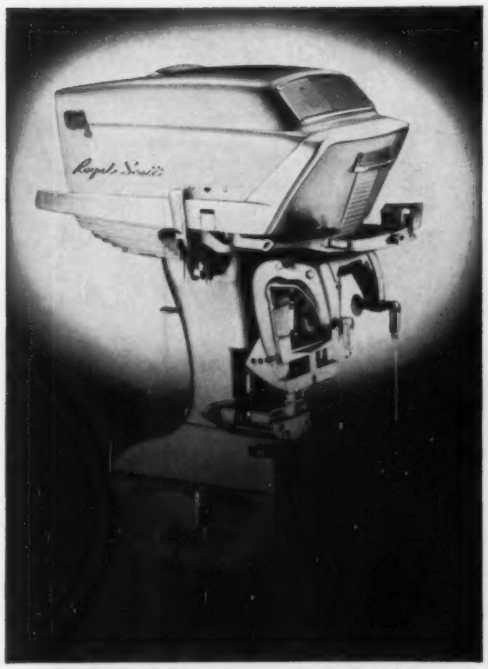
The functional beauty – always

AIRPORT RUNWAY MARKER LIGHT utilizes dome of LUCITE which controls the high-intensity light beam redirected from the sub-surface source. LUCITE is unaffected by operating temperatures of the light . . . retains its excellent optical properties despite weather and aging. (Developed by Stimsonite Division, Elastic Stop Nut Corp. of America, Chicago, Ill.)

NEW BULOVA ELECTRIC RAZOR has inset of LUCITE, reverse surface decorated for attractive, three-dimensional effect. (Inset molded and decorated by Kent Plastics Corp., Evansville, Ind., for Bulova Watch Co., Flushing, N.Y.)

FAUCET HANDLES of sturdy, gleaming LUCITE represent newest styling in plumbing fixtures . . . impart long-lasting beauty to modern bathrooms. (Molded by Keolyn Plastics Inc., Chicago, Ill., for Crane Co., Chicago, Ill., for their "Criterion" lavatory.)

# of Du Pont LUCITE®
an added sales attraction



"ROYAL SCOTT" outboard motor has colorful insignia, owner's "personalization plate" and decorative pieces of sparkling, weather-resistant LUCITE. (Decorative panels molded by Hoosier Cardinal, Evansville, Ind., for Scott-Atwater Mfg. Co., Minneapolis, Minn.)

"ROCKET VIEWER" magnifier, designed by Monte Levin, has three varying-power, precision lenses of clear, shatter-resistant LUCITE . . . body and headband of Du Pont ALATHON® polyethylene resin. (Lenses and viewer molded by Standard Unbreakable Watch Crystals, Inc., New York, N.Y.)

To understand why Du Pont LUCITE acrylic resin is gaining widespread and diversified use, consider the important benefits exhibited here: • Sparkling beauty • Optical clarity comparable to that of finest glass • Strength and toughness • Ease of fabrication • Economy. And these examples are typical of hundreds of other applications . . . decorative and functional . . . which profit from the combination of properties offered by Du Pont LUCITE.

Available either clear or in a wide range of beautiful colors, LUCITE adds a decorative touch to such items as household fixtures, appliances, personal articles, jewelry and ornaments. On the functional side, the durability, transparency and chemical inertness of LUCITE are valuable for industrial applications. And constant formulation improvements are enabling design engineers to find even more uses for this amazing material.

An improved formulation of LUCITE 140 is now widely used for molding heat-resistant parts. Flow at usual molding temperatures is greater, allowing for lower ram pressures, easier ejection, smaller gates and more economical trimming. But the thermal stability of LUCITE 140 also permits molding temperatures 30°F. to 50°F. higher than those possible with molding powders previously available, allowing a further increase in flow and giving parts with slightly higher service temperature at no loss of brilliance or durability.

• • •

Why not investigate the advantages of LUCITE for yourself? For property and application data, simply clip the coupon.

Watch the Du Pont "Show of the Month"—Ninety minutes of the best in live television—CBS network.

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Please send me more information on Du Pont LUCITE acrylic resin. I am interested in evaluating this material for_____

_____

*Name*_____

*Position*_____

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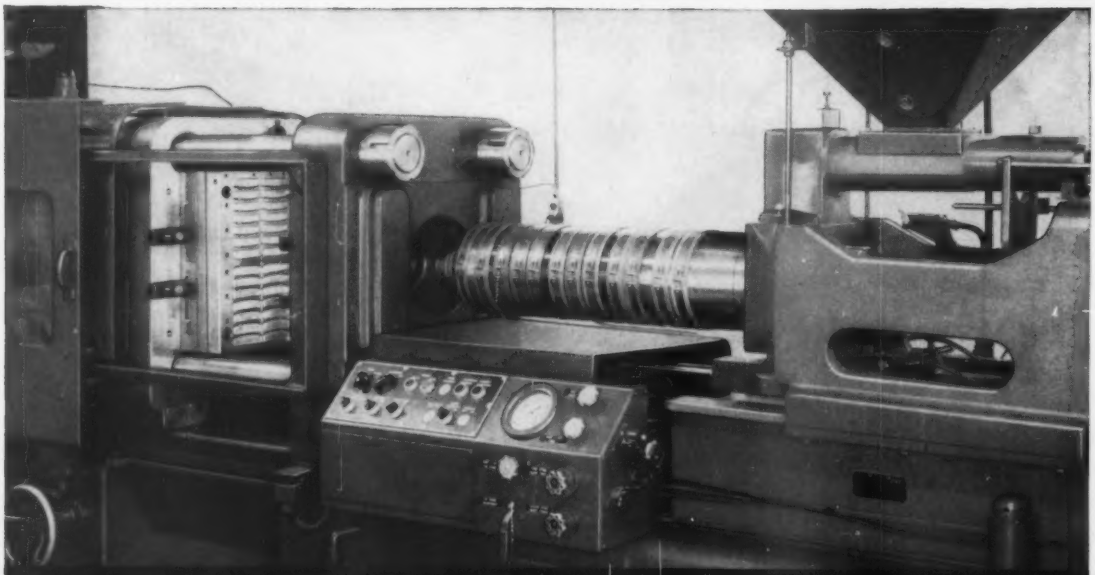
*Type of Business*_____

NEW REED JUMBO HEATERS...



At Superior Comb Co., Leominster, Mass., this 300TA—12/16 oz. REED, equipped with a Jumbo heater, is running a 56-cavity comb mold for National Comb Co. On a similar 24-cavity styrene comb shot weighing 8½ oz., Superior cut cycle time 25% with this machine and increased production by over 1,000 combs per hour.

Now available on New REEDS . . .

JUMBO HEATING CYLINDERS

This new REED Jumbo, available as optional equipment, is the best heating cylinder you can get today. Another product of advanced Reed-Prentice engineering, the Jumbo is the only heater to give you all these advantages:

Greater capacity— The Jumbo is big, and built to handle more material per hour. You're assured of fast, thorough plasticizing with close, three-zone temperature control. Shrink-fit construction of torpedo means better heat transfer, and no drag on fins.

Faster molding— You run heavier shots, fill the mold faster, and cut cycle time. The Jumbo operates at lower temperatures, helps you reduce curing time in the mold.

Leakproof construction—REED engineers have developed a new, three-piece construction for the Jumbo. This means you have *only two seams*, and far less chance of leakage than with other heating cylinders.

Easy to clean— Special features make it easier to remove, disassemble and clean the Jumbo when necessary. With this new REED heating cylinder, you lower your heater maintenance.

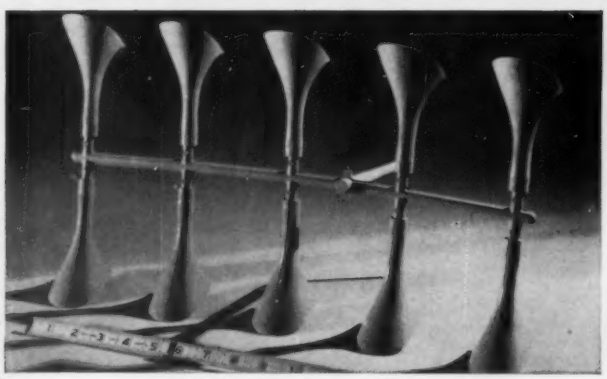
Jumbo heaters are available for these REEDS: 175T (and TL) — 4/6 oz.; 275T — 8/10 oz.; 300TA (and TL) — 12/16 oz.; 400 T — 16/20 oz. For further information, call your Reed-Prentice Sales Engineer today.

Engineered for Modern Molding

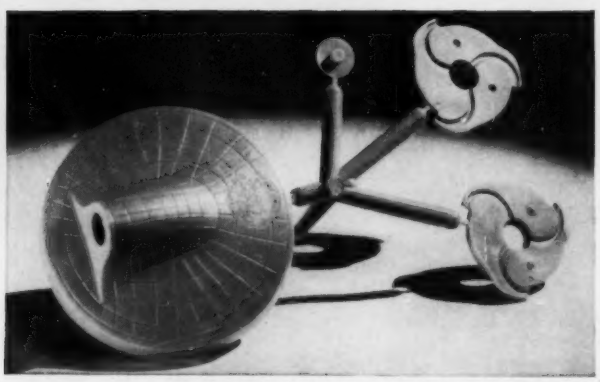
"WE'VE CHOSEN REEDS FOR OUR REPLACEMENT PROGRAM"

SAYS JOHN J. BACHNER,
President of Chicago Molded Products Corp.

"We focus our efforts on two main objectives — turning out superior molded parts and doing it in a way and at a price that saves money for our customers. We've built a reputation we're proud of on that policy. But we know we couldn't continue to do it, nor could we remain one of the country's top molders, with old equipment. That's why we have a program of planned machine replacement. Within the last year alone we've purchased six new REEDS in 4-, 8-, and 12-oz. capacities. These give us superior finished products, along with high production and low maintenance. Having watched these new REEDS perform for us, I don't see how any molder can satisfy customers today with outdated equipment."



This 10-cavity shot of ladies' shoe heels weighs 24 oz. in acetate. A 300TA—12/16 oz. REED equipped with the new Jumbo cylinder handles this job on a 65-second cycle.



Missouri Valley Plastics Co., Inc., Kansas City, Mo., uses a 175T—4/6 oz. REED, with built-in stuffing arrangement and Jumbo cylinder, to mold these auto washing brush parts. The 6½ oz., 4-cavity shot is high-impact styrene.

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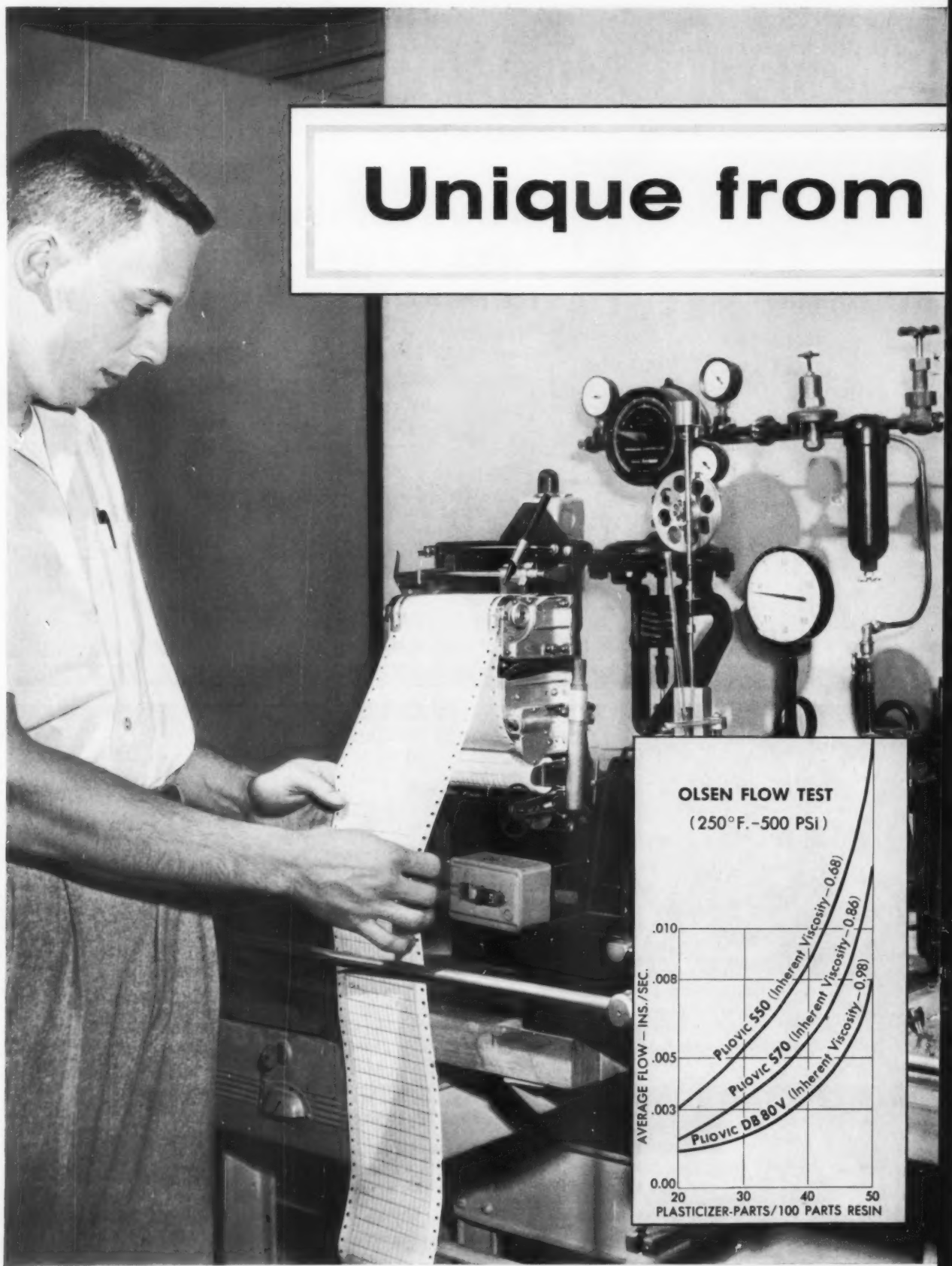
OLSEN FLOW TEST
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.003
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PLIOVIC S50 (Inherent Viscosity – 0.68)
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PLIOVIC DB 80V (Inherent Viscosity – 0.98)
20
30
40
50
PLASTICIZER-PARTS/100 PARTS RESIN

the word – FLOW

That's the new PLIOVIC S50: Completely unique in its superior plastic flow properties. (See data on opposite page.) PLIOVIC S50 is a new kind of unmodified polyvinyl chloride resin of very low viscosity characteristics – in fact, the first modern homopolymer of this type to be offered commercially.

As a result of this lower viscosity, compounds based on PLIOVIC S50 offer these definite processing advantages:

1. Excellent processability at temperatures up to *50°F. lower* than conventional PVC resins.
2. Easy processing without plasticizers.
3. More faithful reproductions in intricate dies and molds.

At the same time PLIOVIC S50 maintains other properties consistent with those of unmodified vinyls.

There are a number of possible uses for PLIOVIC S50. Most interesting of these is its replacement of copolymer resins in molded, extruded or calendered goods where superior flow plus excellent physical properties are needed. It also can be used in blends to improve the processability of higher molecular weight resins.

If you want to benefit from the word "flow," why not write, today, for full details, including the latest *Tech Book Bulletins*, on PLIOVIC S50. Ask also about the other–both new and established –members of the PLIOVIC family. They're all designed to give you definite product or processing advantages. Address: Goodyear, Chemical Division, Akron 16, Ohio.

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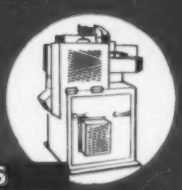
GRANULATORS



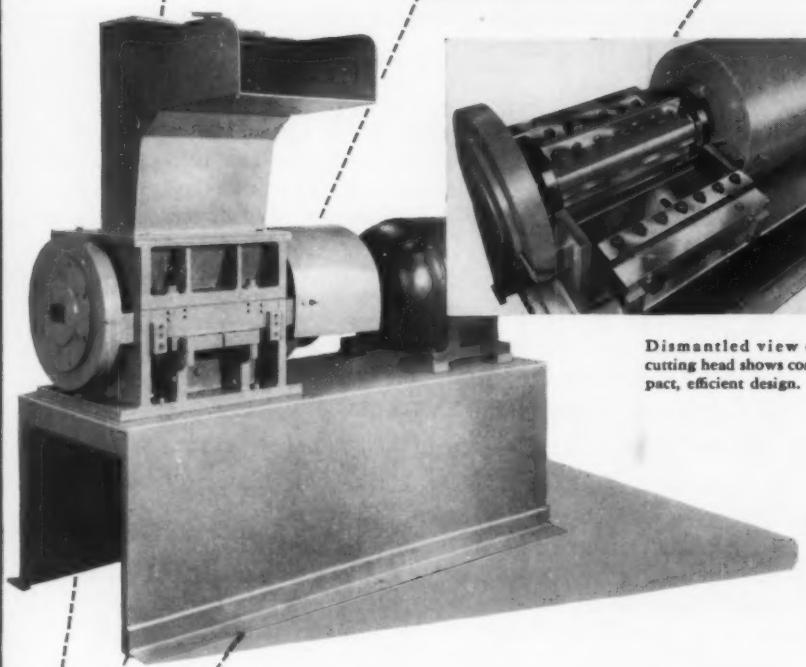
DICERS

CHOPPERS

PREBREAKERS

MODEL 20 All Steel Granulator

CUSTOM ENGINEERED QUALITY BUILT



Dismantled view of cutting head shows compact, efficient design.

1 HEAVY DUTY — Large flywheel—thick all-steel weldments—deep welds—parts are of flawless wrought steel (not steel castings)—machine resists wreckage.

2 LARGE THROAT OPENING — 8 by 20″ size.

3 PRIOR BANDSAWING NOT NEEDED — Machine specially built to handle large chunky parts such as bleeder scrap, cylinder purgings and heavy cast slabs of polystyrene, modified polystyrene and acrylic resins.

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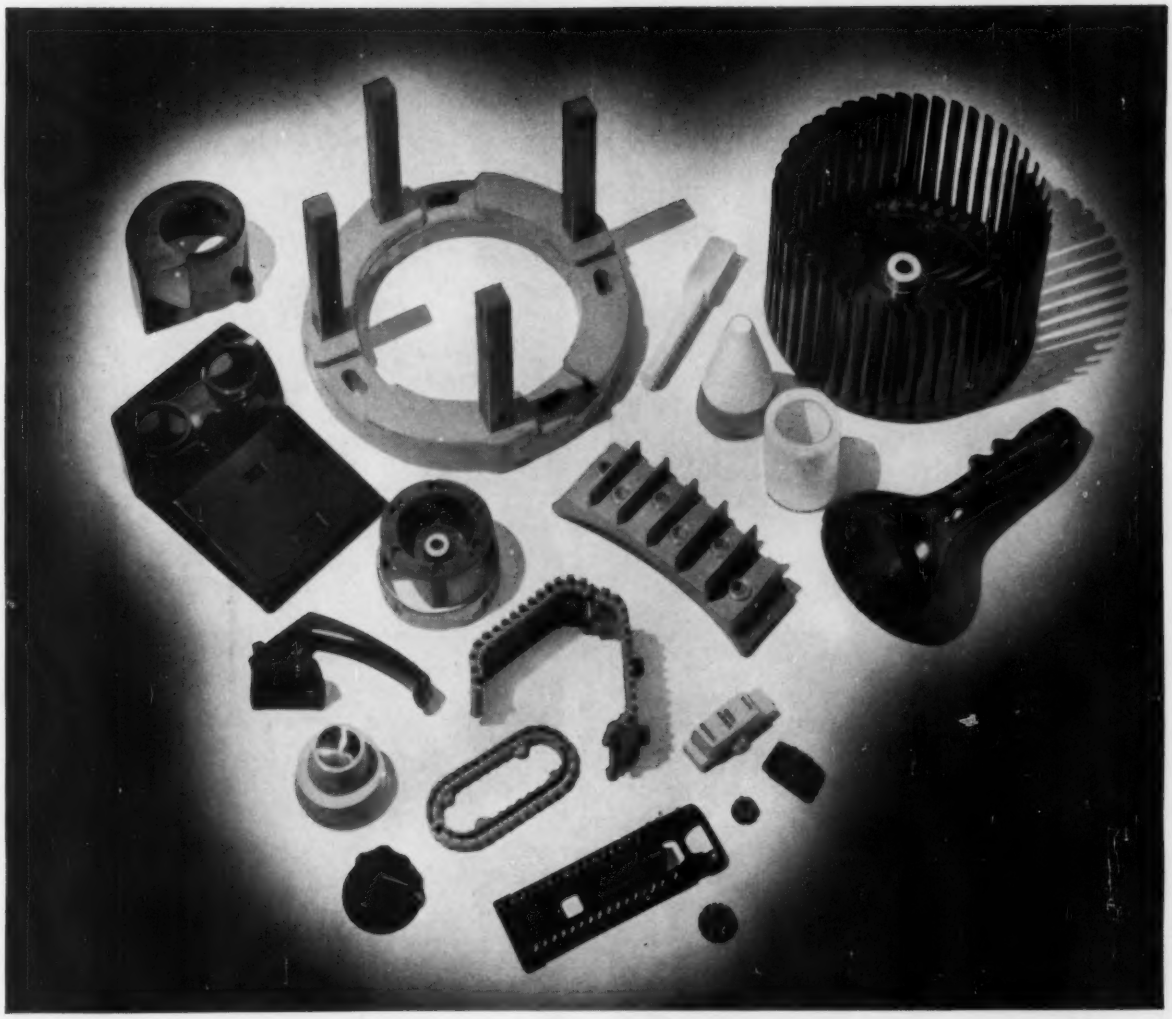
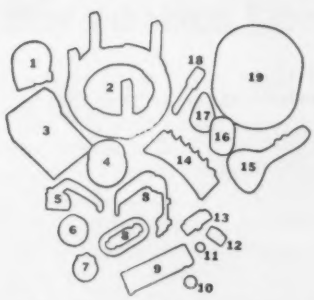


prime source for molded parts



1. impeller housing. **2.** rocker ring. **3.** stereo viewer. **4.** fuse nose. **5.** appliance handle. **6.** and **7.** knobs. **8.** and **9.** terminal boards. **10.**, **11.**, and **12.** miniaturized parts. **13.** organ key. **14.** terminal board. **15.** spinning reel handle. **16.** valve liner. **17.** fuse nose. **18.** organ key. **19.** blower wheel.

For three good reasons, Kurz-Kasch is a prime source for molded thermosetting plastic parts. *First: money-saving experience.* The parts shown illustrate our breadth of experience and capacity for handling difficult jobs. *Second: money-saving tooling.* We design tools and dies for best long-run production economy. *Third: money-saving deliveries.* You get believable promise dates and your parts arrive on schedule. Call your nearest representative for a quote on your next job. Kurz-Kasch, Inc., 1415 South Broadway, Dayton 1, Ohio.

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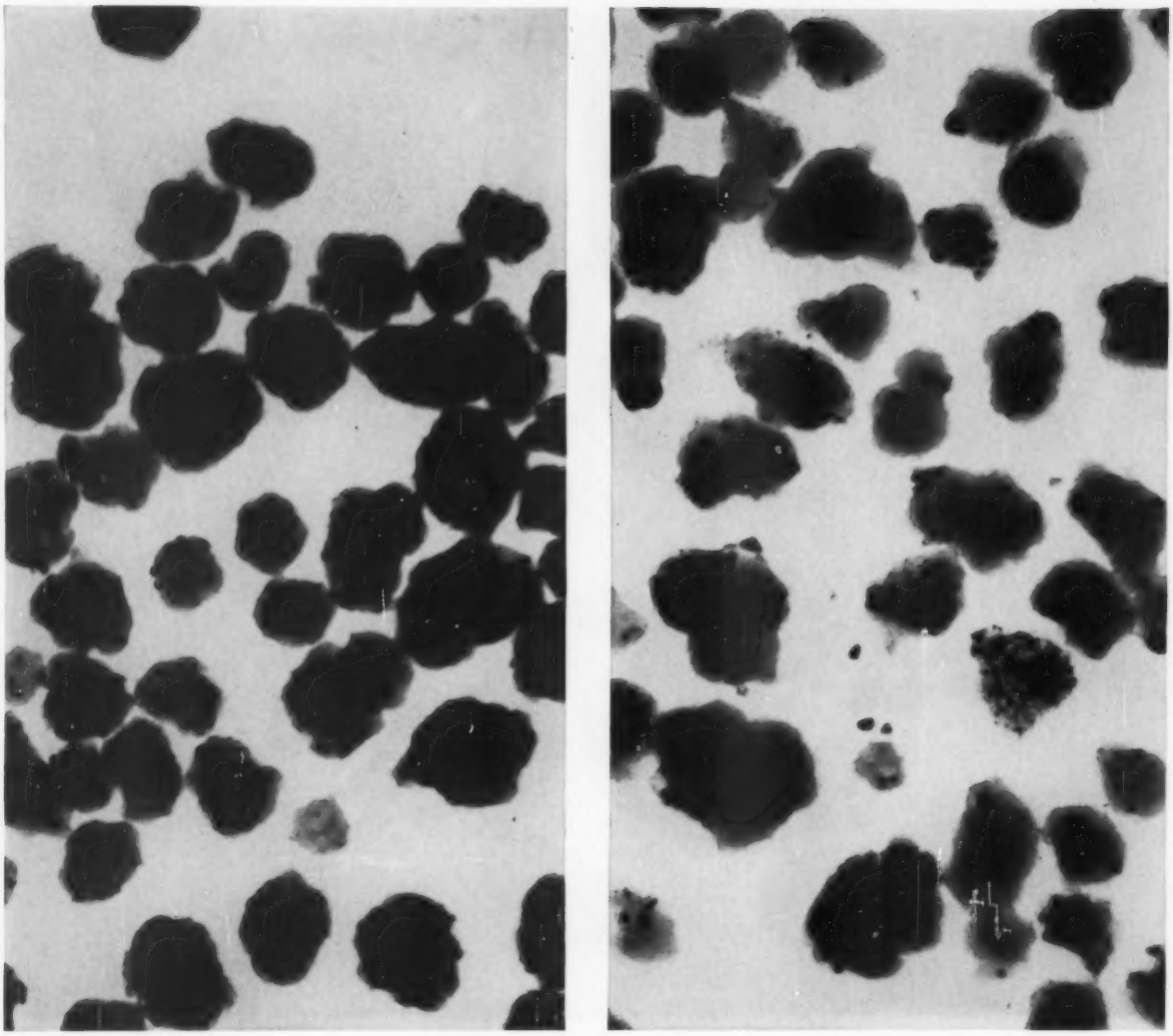

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Cut dry blending cycles . . . boost economy with Dow PVC Resins

Compare the microphotos above. They'll show you Dow PVC Resins absorb plasticizer faster.

Both of the photographs were taken under identical conditions: 4 minutes with the PVC particles completely immersed in di octyl pthalate at room temperature with photo magnification of 105X.

The translucency of the granules in the photo on the right (Dow PVC-133) shows that far more of the plasticizer has been absorbed than by the competitive material at the left. Dark spots are caused by slowly dissipating entrapped air, the presence of which is a further indication of porosity, another fast absorption characteristic—dramatic proof that Dow PVC Resins can cut drying time . . . shorten dry blending cycles . . . effect new economies for you . . . and higher profits.

Dow is a basic producer of vinyl chloride monomers with PVC stocks strategically located to assure you of prompt delivery, whatever your plant location.

Get in touch with your Dow man now for detailed information on PVC Resins . . . and on the entire family of Dow plastics. Or write for technical information to THE DOW CHEMICAL COMPANY, Midland, Michigan, Plastics Sales Dept. 1530B.

America's First Family of Thermoplastics

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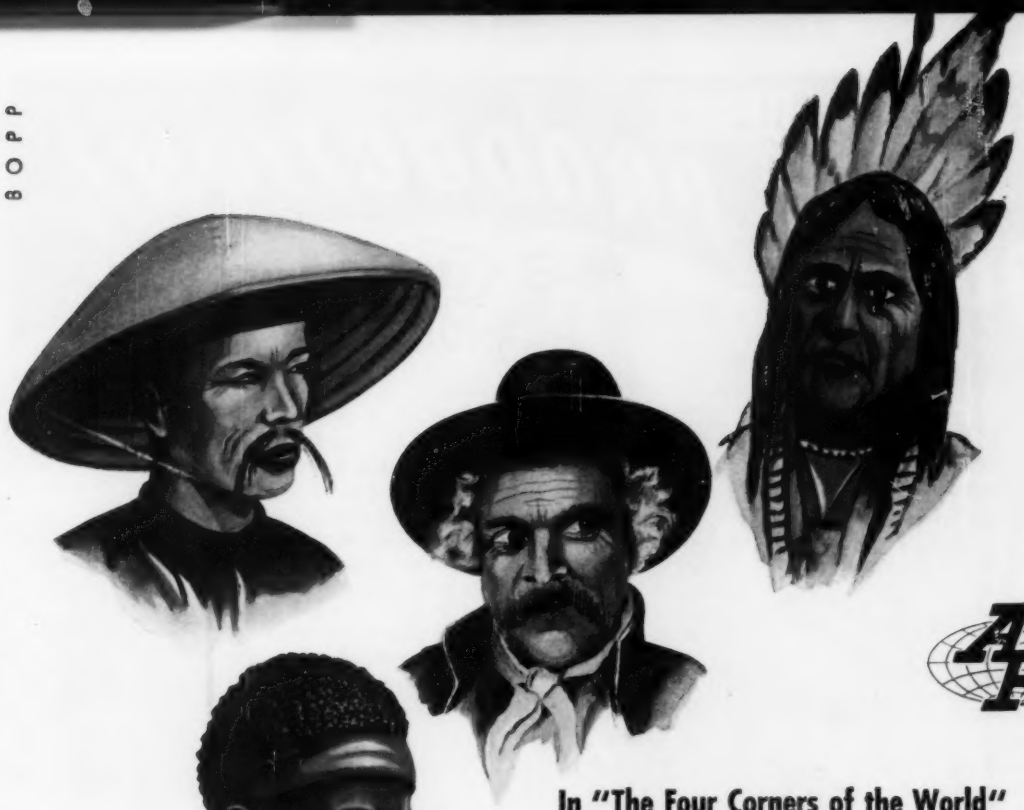

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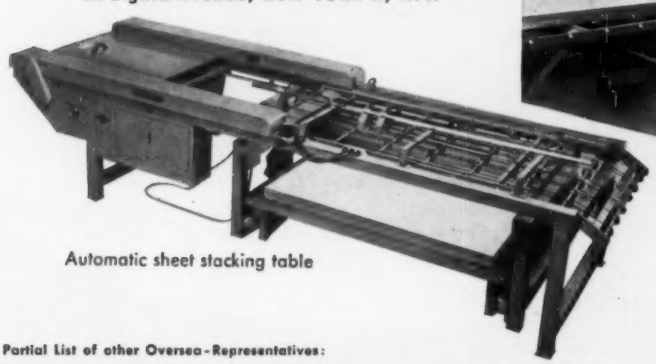
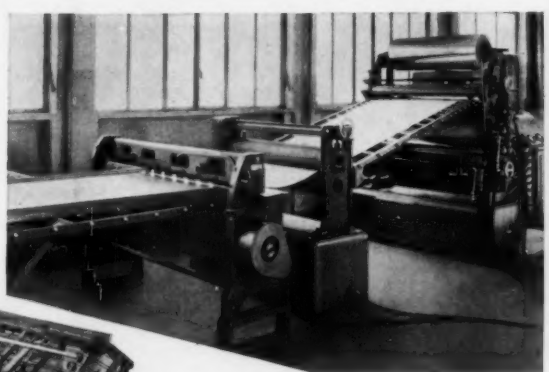


Automatic sheet stacking table



The plant for plastic-sheets
– General view –

Partial List of other Oversea-Representatives:

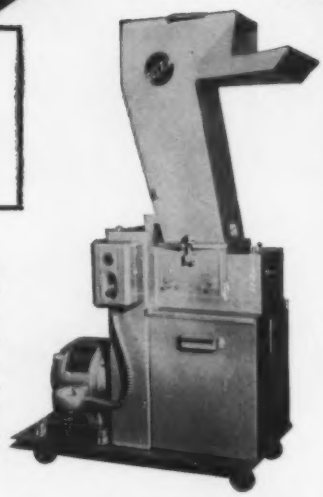
Mexico: Huber de Mexico S. A., Edificio Delta, Melchor Ocampo No. 212 — **Argentina:** Ameriplastes, Córdoba 330, Buenos-Aires — **Brazil:** Panambra S. A., Av. Senador Queiroz 86/96, Sao-Paulo — **Columbia:** Isy Neumann, Apartado Aereo 6557, Bogota — **Venezuela:** Remedia S. A., Apartado 3754, Caracas

INJECTION MOLDERS!

BOOST PRODUCTION!

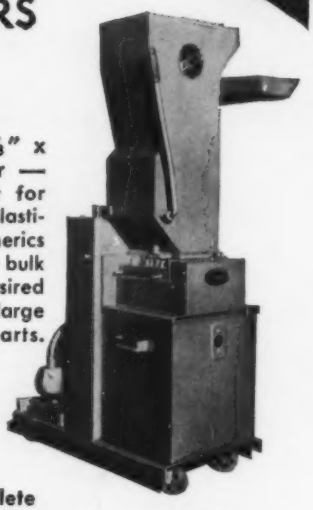
M-3 IMS M-4 GRANULATORS

All machines illustrated here in stock for prompt delivery.



The IMS M-3 6½" x 7" throat sprue grinder — rugged — simple in design — easiest to clean — built-in throat clearance bar — casters — catch pan.

PRICE: Complete with 1 HP Motor and Starter $598.50



The IMS M-4 5⅜" x 8½" throat grinder — designed primarily for vinyl, polyethylene, plastisols and all elastomerics where a fine-free low bulk factor product is desired — large throat for large injection molded parts.

PRICE: Complete with 2 HP Motor and Starter $788.50
Same, but with 3 HP Motor $854.00

CONSTANT MOLD TEMPERATURE REGULATOR

The IMS Economy Circulator — **priced at only $369.50 complete (oil model for heats to 450° at $482.50)** — duplicates performance of mold heaters costing up to 6 times as much — developed by a molder for molders — compact — portable only 15" x 22½" floor space.

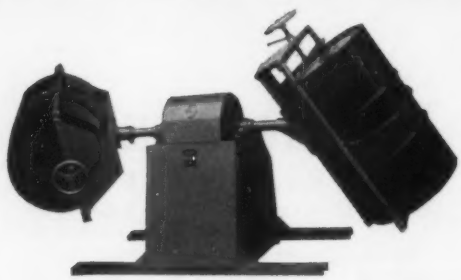
NOTE: Special price for 2 units .....$349.50 Each

Send for our 1957 Nozzle Catalog and Heater Band Book Today. You'll find all styles of nozzles and heater bands fully described and priced, with technical notes on nylon molding.

Prompt service on all kinds of nozzles by the world's largest and most experienced nozzle specialists.

IMS DRUM TUMBLERS

FOR ALL COLORING AND MIXING OPERATIONS



All IMS Drum Tumblers are based on design suggestions of the leading material and colorant suppliers. Available for immediate shipment from stock.

¾ HP Model $595.00
(Takes drums up to 33" high x 22" in diam.)
2 HP Model $897.50
(Takes drums up to 37" high x 23¼" in diam.)
3 HP Model $1285.00
(Takes drums up to 45" high x 24" in diam.)

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How Tycoon Plastics Builds Profitably with H-P-M Injection Molding Machines

Not too long ago, Tycoon Plastics of Miami, Florida, was receiving shipment on their first H-P-M Plastic Injection Molding Machine—a 6/8-oz. machine illustrated below. Since that time, two more H-P-Ms have been added, including a 12/16-oz. and a 20/28-oz. machine. Growth such as this is not uncommon in the busy South. H-P-M has played an important part in the production growth of many companies like Tycoon. You, too, can standardize on H-P-M equipment for successful plastic molding . . . injection, compression, transfer, and the molding of reinforced plastics. There's an H-P-M for the job—and they're tops with molders in busy shops all over the world.

HPM 6/8 oz.

Nylon fishing rod guides and rollers, shot weighs 4 oz.

HPM 12/16 oz.

This is a 12-oz. machine molding Butyrate anchors in a 10-oz. shot.

HPM 20/28 oz.

An 18-oz. shot on this 20/28-oz. H-P-M molds polyethylene parts.

H808

Write today for Bulletin 5701-A describing HPM's complete line of plastic injection machines—they're built for real service.

THE HYDRAULIC PRESS MFG. COMPANY

A DIVISION OF KOEHRING COMPANY • MOUNT GILEAD, OHIO, U.S.A.

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Unusual applications of precision molded nylon are routine projects at Quinn-Berry . . . gearing for a multitude of appliance, automotive and aviation components. The nylon gear shown above is molded directly onto the shaft to finish dimensions in one operation. Five separate operations were formerly necessary. The result? A 50% cost reduction and improved performance. Nylon gears by Quinn-Berry require no lubrication. They are quiet in operation . . . known to last 20 times longer than gears of other materials in many applications . . . have exceptional ability to withstand vibration.

Quinn-Berry is a pioneer in the precision molding of nylon as well as other thermoplastic materials. For your component parts, put it up to Q-B where the "Unusual is Routine."

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for HIGH mold temperatures

PLENCO 470

G. P. BLACK

Provides fastest cures (without case-hardening) at molding temperatures in excess of 350°F. Excellent preforming characteristics . . . mold finish . . . as well as pourability and no-stick ease of operation. New 470 Black is ideal for a wide variety of applications. Flow range hard to soft.

for LOWER mold temperatures

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Assures fastest cures at lower molding temperatures of up to 325°F. Made with single-stage resin, new 480 Black has excellent molded properties with freedom from mold staining . . . ideal pourability, operating ease and economy of use. Flow range hard to soft.

PLASTICS ENGINEERING COMPANY
Sheboygan, Wisconsin

PLENCO PHENOLICS
FOR BETTER PLASTIC PRODUCTS

Serving the plastics industry in the manufacture of high grade phenolic molding compounds, industrial resins and coating resins.

Plastic Playthings Are

Hi-fax® Holds the Key to Stronger Products, Stronger Sales— Now Commercially Available!

Strength is a *must* in quality playthings. Design, color and finish all count, but in toys for the toddler or sporting goods for children of all ages the practical plaything is the one that stands up . . . unaffected by weather, use or abuse.

Hi-fax—Hercules' new high density polyethylene—now makes possible the design and merchandising of truly practical playthings possessing all the versatility, eye-appeal and built-in play values only plastics can provide. Thanks to Hi-fax, plastic playthings are going stronger . . . in function and in sales.

Hi-fax—already proved-in as an outstanding toy material—is now available in commercial quantities to quality standards that meet Hercules' high requirements for uniformity and performance. Add new strength to your products and a strong boost to your sales with Hi-fax. Call or write.

Cellulose Products Department

HERCULES POWDER COMPANY
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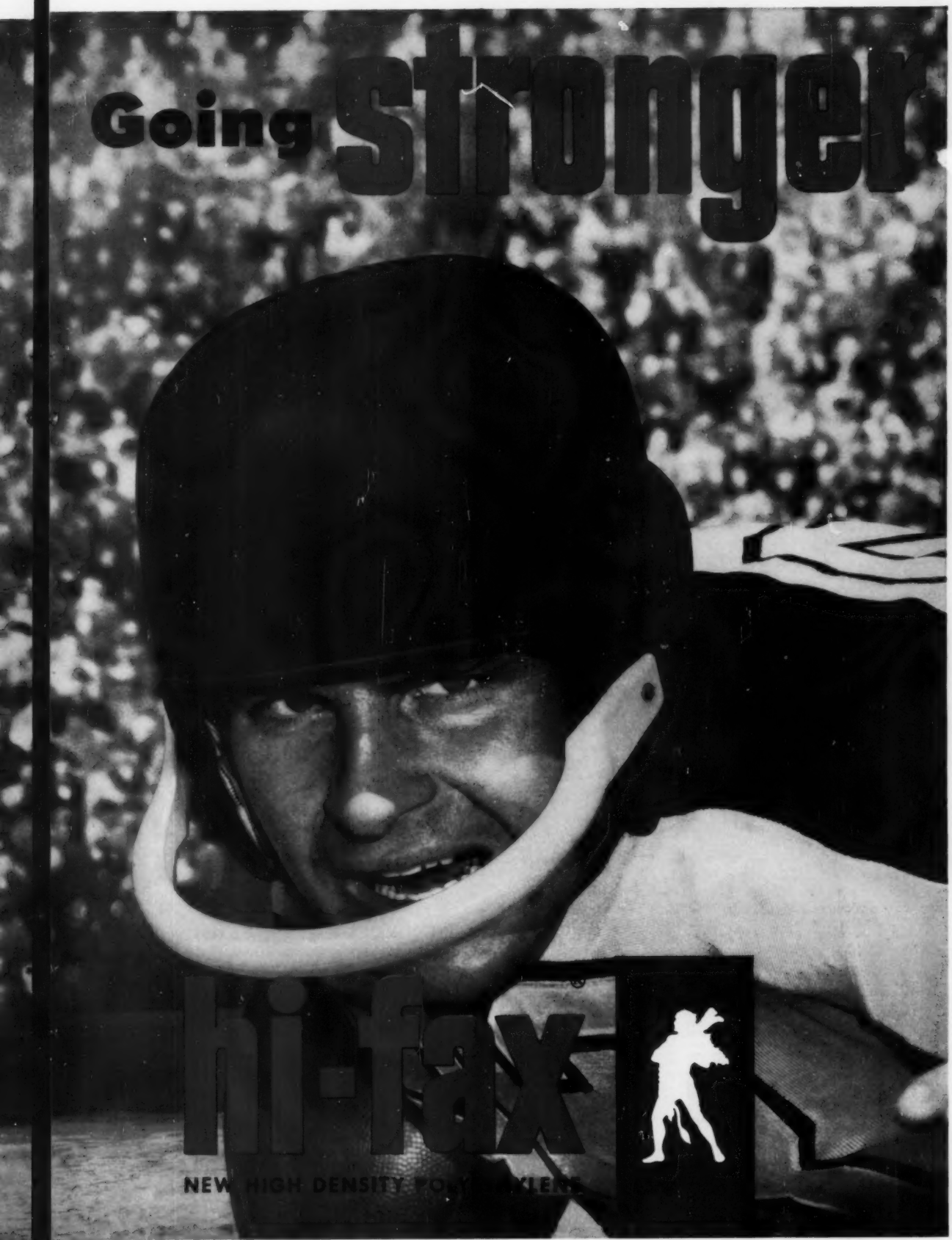
STRONGER FOOTBALL HELMETS—this sturdy new helmet was molded from Hi-fax. ▶

CP57-6

Benjamin Michtom
Chairman of the Board
Ideal Toy Corporation

LEADING TOY MANUFACTURER LOOKS AT HI-FAX

It's my business to know all I can about toys. Today that naturally means knowing all I can about plastics, for plastics are the number one materials used in the manufacture of modern playthings. I am particularly glad to see such a revolutionary new plastic as Hi-fax appear. The unusual combination of properties provided by Hi-fax will make it possible for me to plan even better quality in Ideal's future products. That's important to us because next to the child's own desire for an Ideal toy his parents' insistence on quality is the most important factor in every sale.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New 1½-oz. push-up containers . . . available in clear plastic or a wide variety of opaque and transparent colors, with white opaque, snap-on caps.
For example—
Spouts and caps for aerosol shaving lather containers.
For example—
A handy tumbler.
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New 4½-oz. Plastainer jars with stacking feature . . . available in a wide variety of opaque and transparent colors, with screw caps.

Owens-Illinois packaging know-how and high-quality standards offer you the finest in plastic molding facilities . . . Injection molding . . . Compression molding . . . A complete range in plastics for packaging, for specialties.

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Fellows Leads Again!

Now Fellows introduces the new *"12-350"* Injection Molding Machine! It's the fastest fully-automatic 12-ounce machine on the market . . . dry cycles at 700 cycles per hour, makes shots up to 20 ounces (with the optional Pre-Pac device)! It's even *faster* in operation than many smaller machines!

Fellows 12-350 handles mold bases up to 20¼" by 33" with 14" draw. Precision controls, grouped for convenience, make set-ups fast and simple for every job, minimize adjustments during the run. Optional kit makes it fully automatic: an operator can run more than one machine.

Ask your Fellows Representative for complete information about the Fellows 12-350 and the other profit-producing Fellows Injection Molding Machines. And ask him about the Fellows Plans for deferred payment, two ways to pay for your machines while they're producing. Just write, wire, or phone any Fellows office.

Fellows

injection molding equipment

THE FELLOWS GEAR SHAPER COMPANY, Plastics Machine Division, Head Office and Export Department: Springfield, Vermont
Branch Offices: 1048 North Woodward Ave., Royal Oak, Mich. • 150 West Pleasant Ave., Maywood, N. J. • 5835 West North Ave., Chicago 39
6214 West Manchester Avenue, Los Angeles 45

The brilliant gloss of molded products made from Spencer "Poly-Eth" 1408.5 is demonstrated in this photo.

In Polyethylene Molding...

"Poly-Eth" 1408.5 For Gloss:

Ideal for housewares and toys, this easy flow resin gives you gloss, rigidity and fast cycles:

To meet the special needs of housewares and toy molders, Spencer Chemical Company has developed a polyethylene resin that gives you greater rigidity, better gloss, faster cycles and less trouble with warpage. This resin—called "Poly-Eth" 1408.5—has been proven in production-line use and is now available to you in commercial quantities. Here is how "Poly-Eth" 1408.5 can help improve your production and give your products more sales appeal:

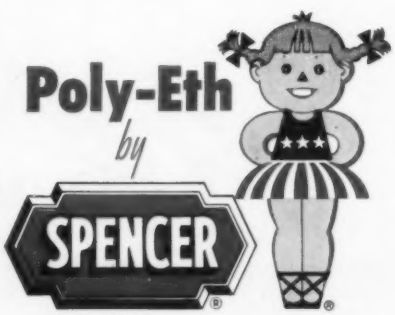
A vivid, shiny gloss can be obtained by using simple dry coloring. No special mixing is needed. And "Poly-Eth" 1408.5 is non-toxic.

The high melt index (20) of "Poly-Eth" 1408.5 gives it outstandingly good flow characteristics. Also, this resin has a higher density (.924). Because of its added rigidity it sets up faster than conventional resins. That means it's ideal for filling both single and multiple cavity molds.

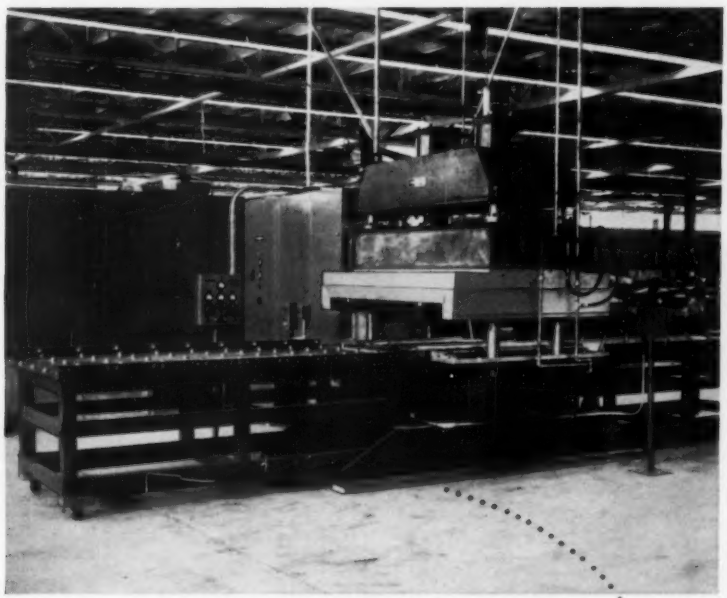
A special balance of properties means that "Poly-Eth" 1408.5 gives you less trouble with warpage. As a result, you should be able to produce more saleable products with fewer rejects.

For still greater stiffness and high heat resistance, combined with high gloss, get Spencer's exclusive test-proven "Poly-Eth Hi-D" polyethylene resin. Available in Melt Index 1 (1504) and Melt Index 2 (1506).

Discover for yourself why so many molders prefer the polyethylene that *flashes* sales appeal—glossy "Poly-Eth" 1408.5. For complete information, write to Spencer Chemical Company, Dwight Bldg., Kansas City 5, Missouri.



How the new car interiors get that luxury look



One of several large Thermatron units recently installed at the Owosso Mfg. Div. plant of Mitchell-Bentley Corp. Includes a dual frequency 50 KW dielectric generator for safer and faster welding at lower voltage. Patented arc suppressor has dual sensitivity range for large and small areas. Water cooled platen of the 100-ton press reduces post cycle hold-down time.

New Thermatron installations quilt and weld vinyl plastic door panels and upholstery

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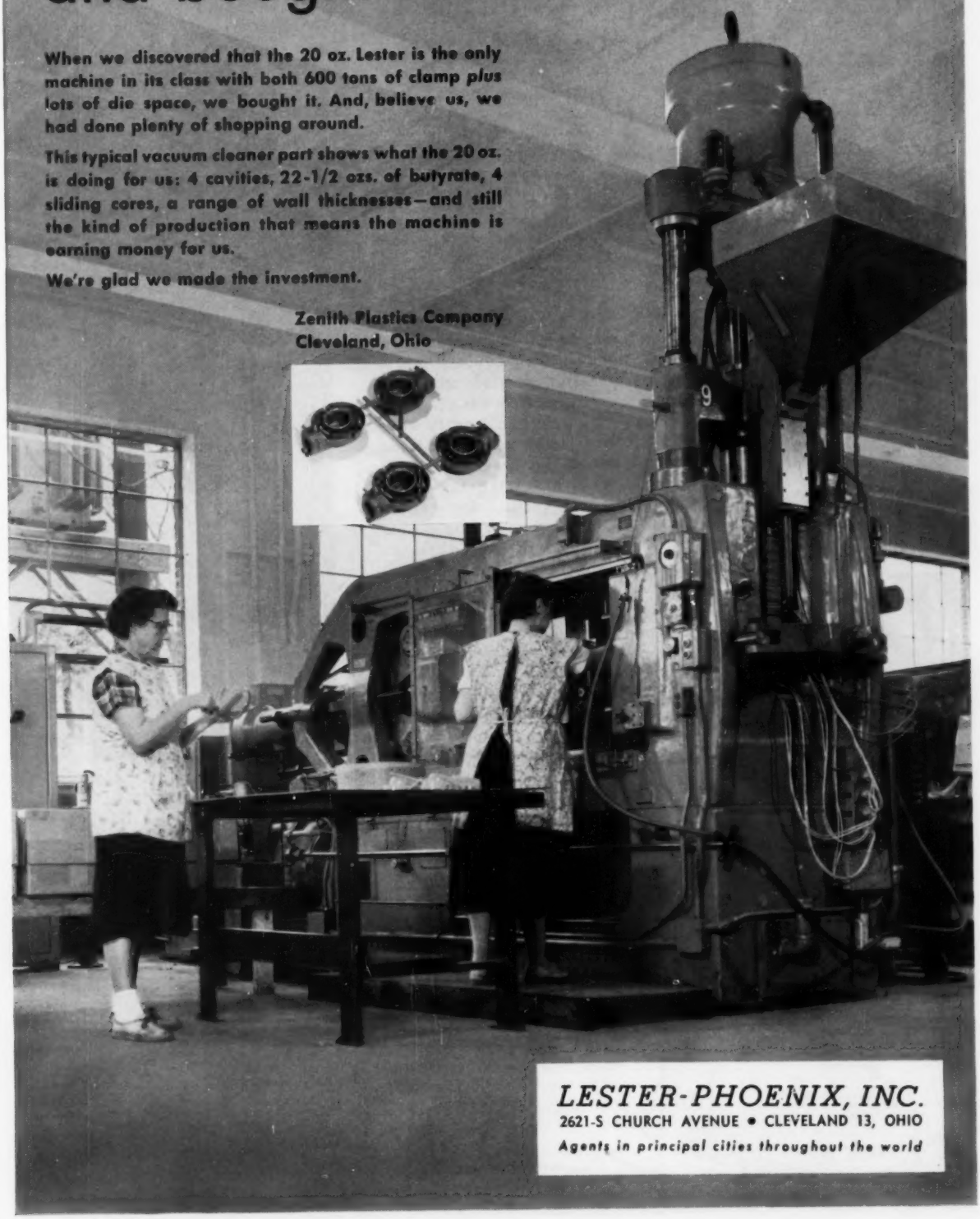

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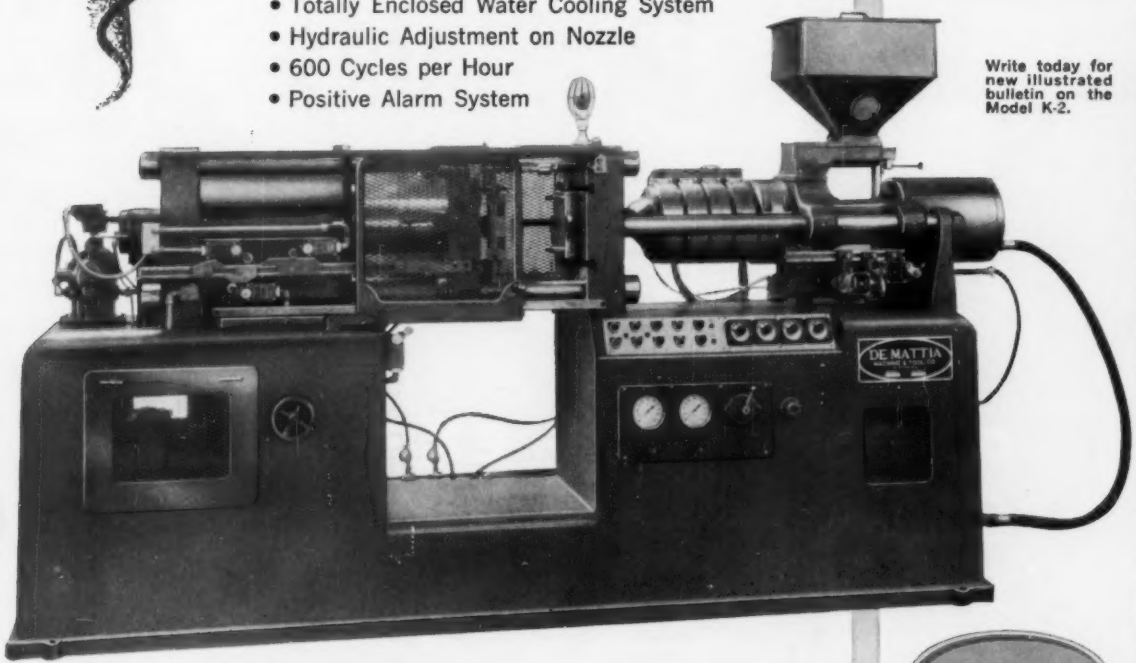

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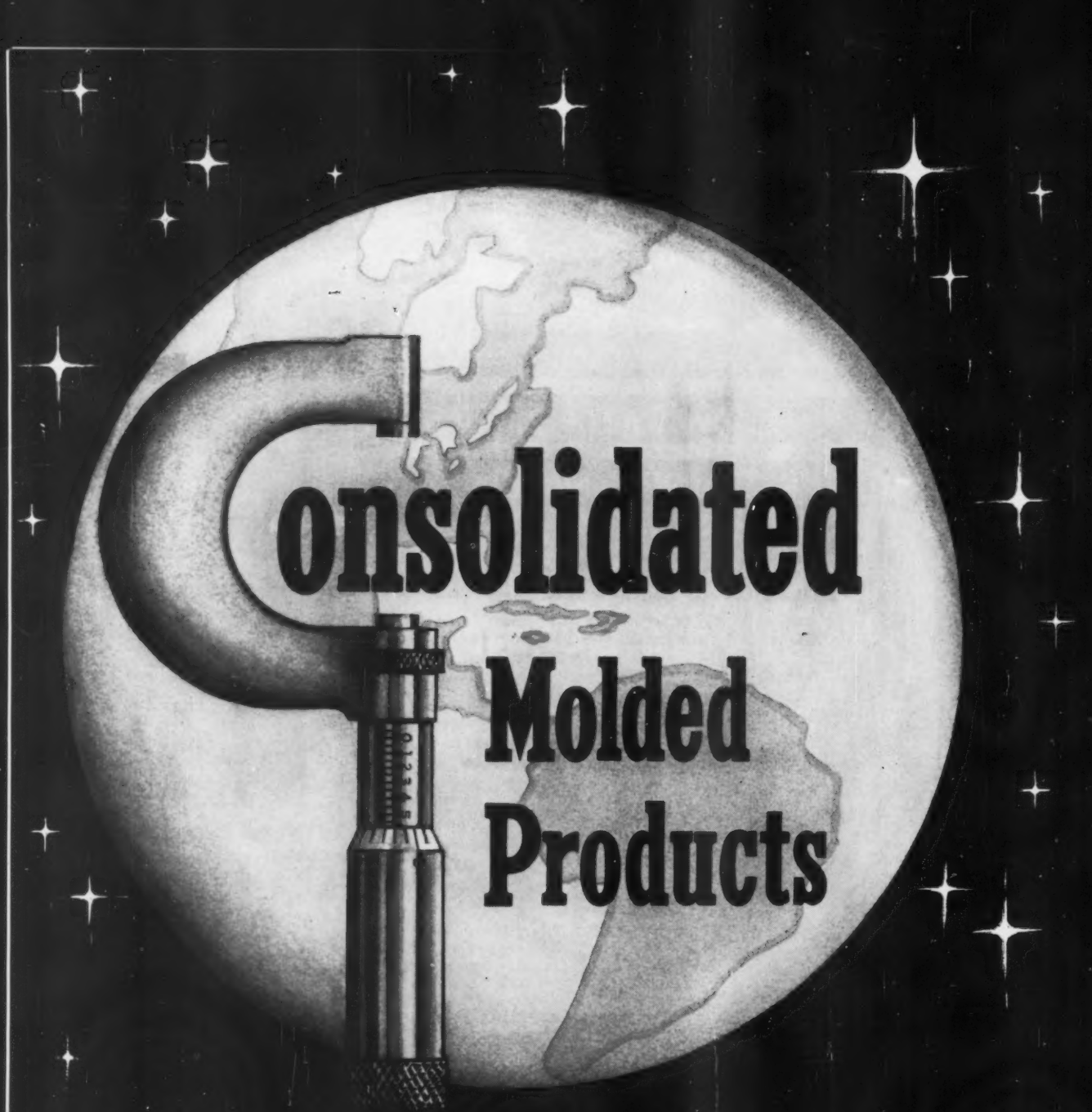

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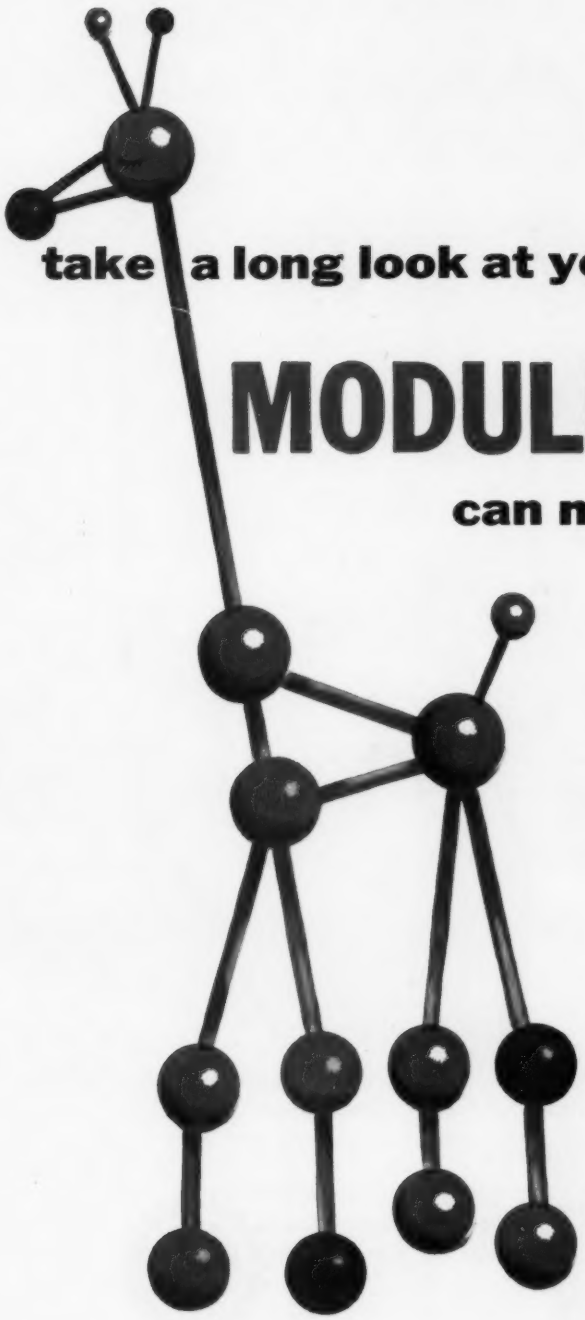

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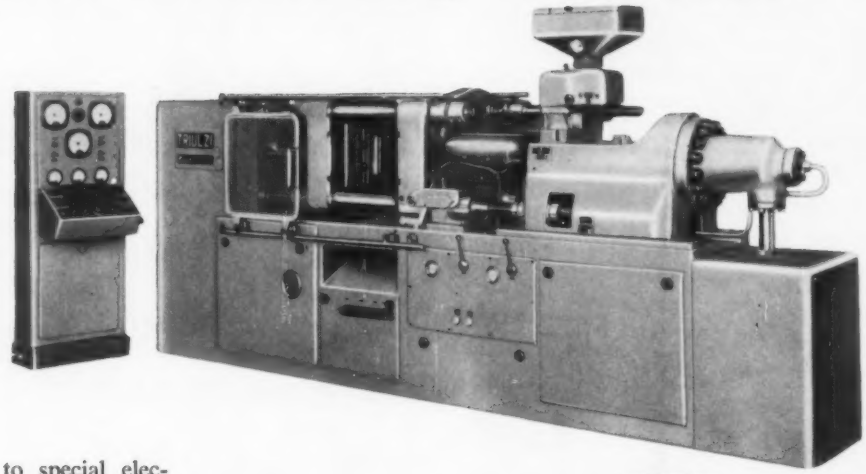

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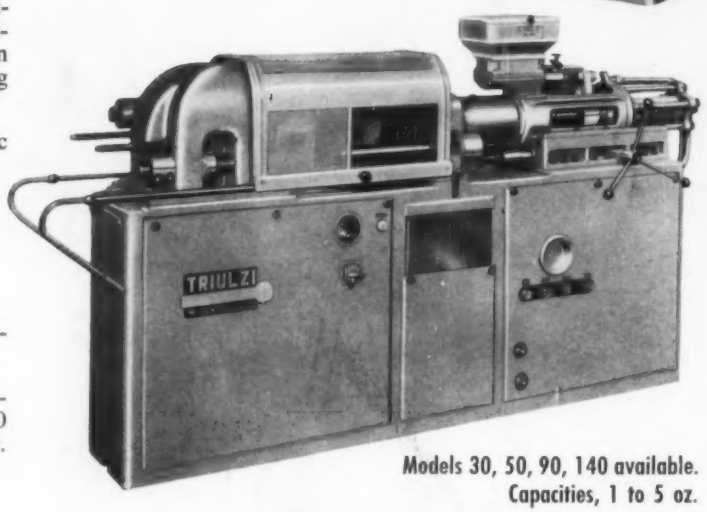

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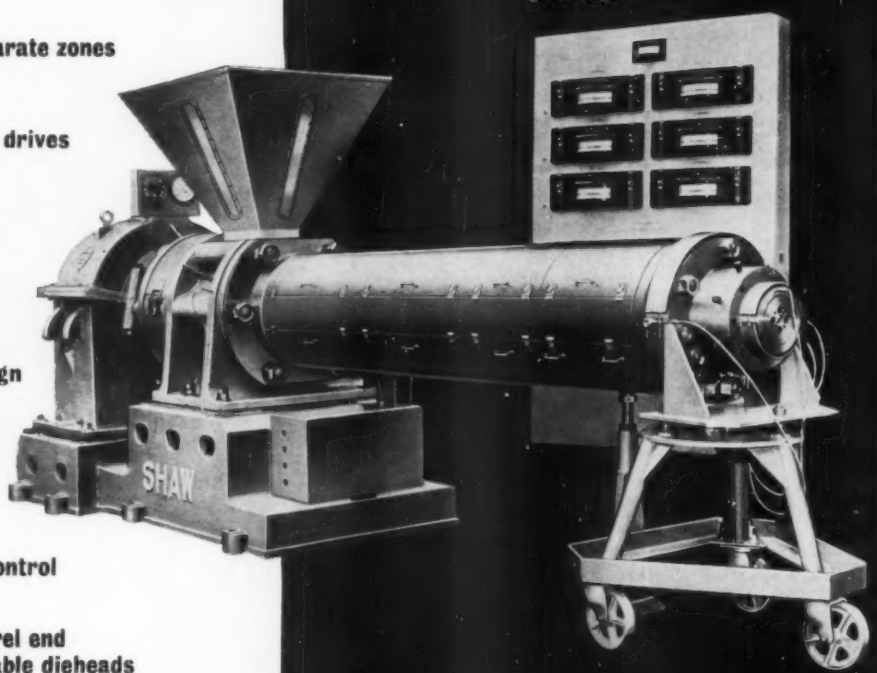

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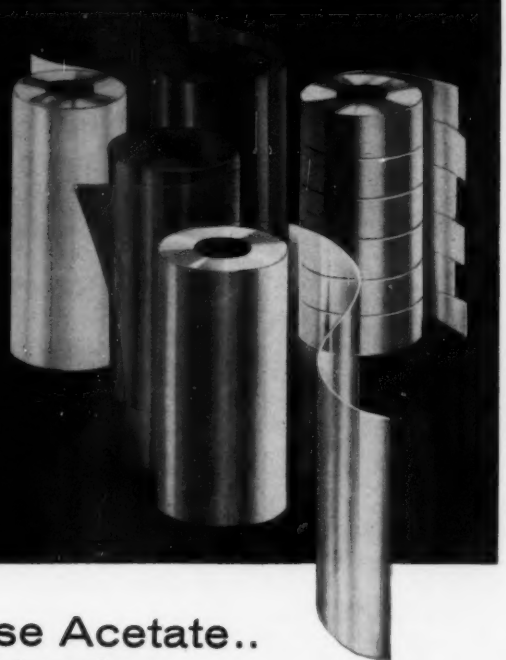

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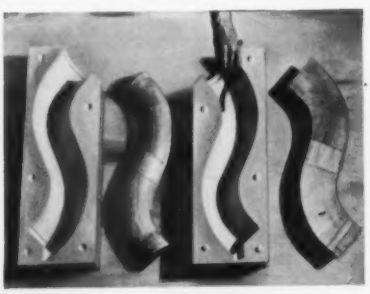
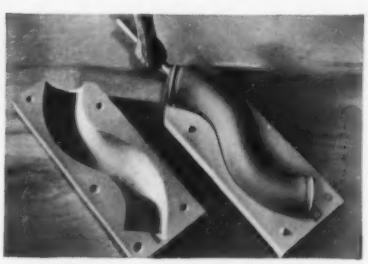
HOW BESTWALL® BREAKAWAY PLASTER CAN HELP YOU IMPROVE PRODUCTION OF HOLLOW, SEAMLESS PLASTIC PARTS

Malcor forms this aircraft duct easily, economically, to close tolerances around an expendable, dissolvable breakaway core

←Key step in the process at Malcor, plastic tooling, model and pattern maker, of Media, Pa. The Bestwall Breakaway Plaster core is easily dissolved out of the finished impregnated glass fibered cloth duct by simple immersion in hot water.



The part to be made is first modeled in wood. From this a plaster mold is cast. Malcor uses Bestwall Sunflower® Plaster here because it's a cool-setting plaster and won't generate enough heat to harm the wooden model.



Into this Sunflower Plaster mold Breakaway Plaster is poured to make a core. When the core is dry, impregnated glass fibered cloth is wrapped around it to form the aircraft duct. After curing, the piece is soaked in a washing tank, and the Breakaway core is easily dissolved—with no chance of malforming or damage to the finished duct. Mr. Malion, of Malcor, says, "Without Breakaway Plaster it would be virtually impossible to produce the variety of shapes we supply to the aircraft and automotive industries."

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date: **DECEMBER 1, 1957**
subject:

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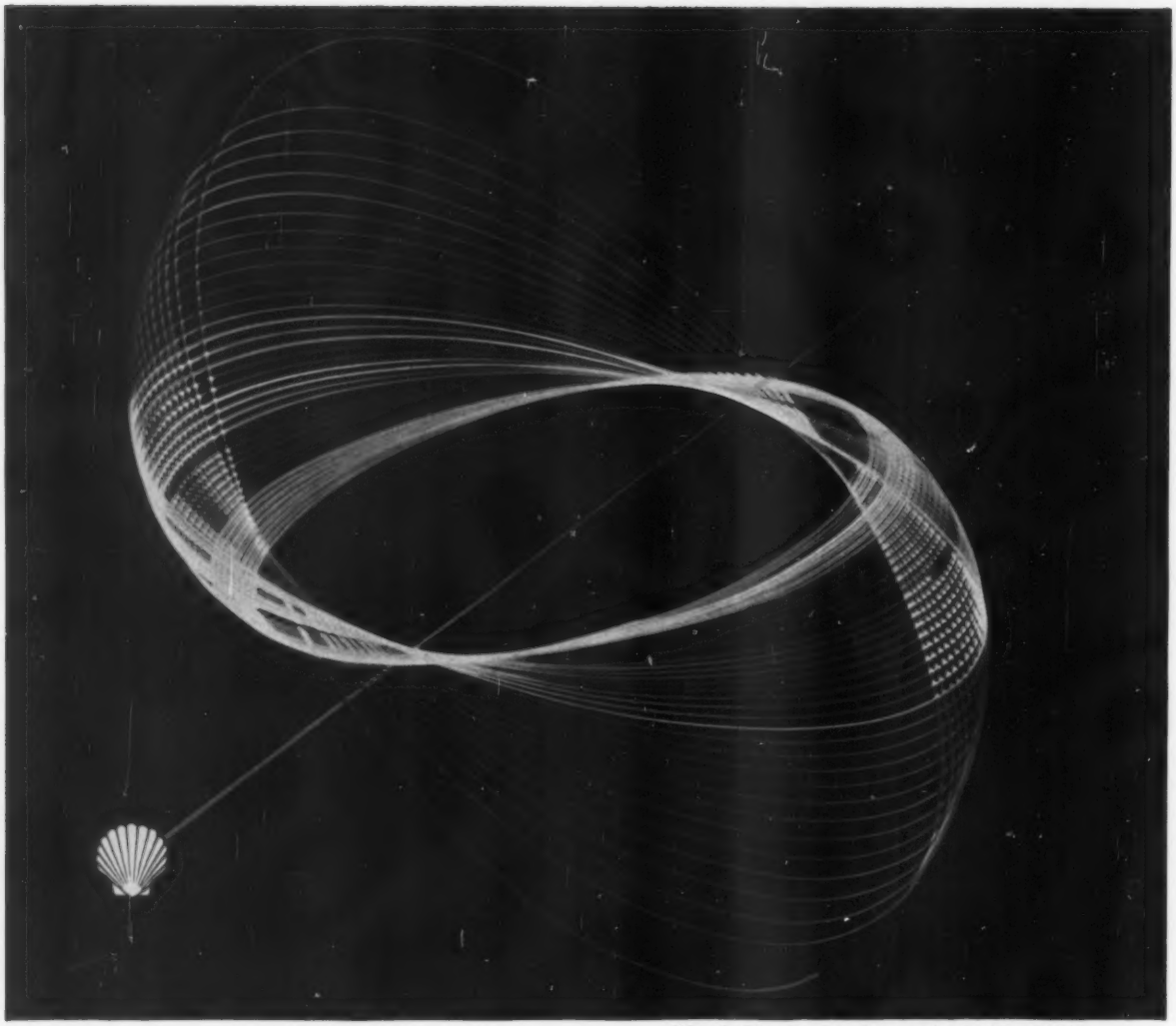

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SHELL

The Plastiscope* December 1957

News and interpretations of the news

By R. L. Van Boskirk

Section 1

Potential outdoor market for Mylar. Possible big new uses for Du Pont's Mylar polyester film are opened by the development of a film that has been modified so that it will weather well when exposed to the elements. Standard Mylar shows signs of weakness after prolonged exposure to outdoor use. The treated film is being test-marketed by Montgomery-Ward and suggested particularly for greenhouses, patio roofs, glazing for chicken coops and other farm buildings, and air-supported structures. The cost—$3.25/lb.—is somewhat above that of Types A and D Mylar, which were reduced to a price of around $2/lb. last September—the fourth price reduction since the film was introduced. Exceptionally thin Type C in 25-gage thickness is still around $4/lb., and 50 gage is $2.75/pound. The C grade is used primarily for metallic yarns, packaging, and certain electrical applications.

Another growing use is in a laminate with vinyl chloride sheeting for use in automotive and refrigerator interior trim. A television and radio producer has been using this Mylar-vinyl laminate instead of metal for some of its cabinets. The same idea is being incorporated for name plates, signs, and decals to replace chrome on machines and other equipment.

However, the three largest uses for Mylar are electrical, yarn, and magnetic tape. Its use in metallic yarn has grown most significantly—market researchers estimate the total as at least 55% of production. There are two types —one is a laminate with foil between two layers of the film; the other is film with vacuum-deposited aluminum on one side and a layer of clear film then laminated to the metallized side for protection. The foil type is generally used for wet-processing in which it may be subjected to extreme heat in washing or ironing. The metallized type is for decorative treatment in dress goods, home furnishings, auto upholstery, and shoes.

Estimators in the trade guess that Mylar consumption has grown from around 400,000 lb. in 1953 to 10 million lb. in 1956; it may go to 15 million in 1958. Du Pont will give no confirmation of these figures.

New acrylate plant in operation. Celanese Corp. has started operation of its new 15 million-lb.-a-year plant for production of acrylate esters at Pampa, Texas.

This production will mark the first use of a new method for making acrylate esters discovered by B. F. Goodrich Chemical Co. The process utilizes acetic acid and formaldehyde, both of which are produced by Celanese at Bishop, Texas.

Consumption of acrylate has doubled since 1954 and is expected to double again by 1960, according to Celanese officials. Their optimism is based partly on increasing use of polymers for paint. Other uses are for paper coat-

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POLYSTYRENE	√	√	√			√	√	
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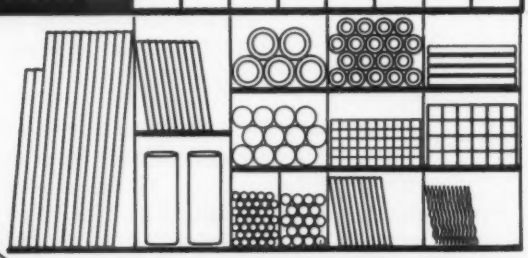
PHENOLIC LAMINATES	√	√	√					



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The Plastiscope

(*Continued from page* 43)

ing; leather finishing; modifying properties for acrylic fibers; adhesives; textile finishes; backings; and in formulations used as backings for carpets and upholstery fabrics.

Carbon black to improve polyethylene pipe. Godfrey L. Cabot, Inc. is building a semi-works plant to produce polyethylene pipe reinforced by its previously announced CAB-XL process (see MODERN PLASTICS *34*, 37, June 1957), which will reportedly increase the burst strength of polyethylene pipe by 50 percent. As much as ⅔ of the compound may be carbon black, but a 50% content is generally used. The principle involved may be roughly compared with that of compounding rubber with carbon black whereby cross-linking is accomplished to obtain a stronger material.

The pipe thus produced is flexible up to 1 in. in diameter and presumably will also be flexible at 2 inches. The pipe is not as stiff as that made from high-density polyethylene but resists creep and stress-cracking up to about 140° F. When used for wire-coating, the compound's electrical properties show increased resistivity over competitive materials and reportedly will outperform neoprene for such purposes.

With carbon black at from 5 to 10¢/lb., compared with 37½¢ for polyethylene pipe formulations, this compound will offer economical advantages; but on the other hand, carbon black is heavier than polyethylene, it has to be handled differently, and must go through a curing stage after cross-linking. Consequently, actual cost has not yet been determined.

Expandable polystyrene. A new steam pre-expander for use in molding expandable polystyrene has been developed by Koppers Co., Inc. Known as the Rodman Steam Pre-Expander, the new expander is claimed to make possible the manufacture of expandable polystyrene beads at lower density than ever before. It will reportedly make possible the manufacture of modular panel cores for lamination to decorative panels on an economical basis.

Koppers has licensed the commercial manufacture of the Pre-Expander to two other manufacturers—F. F. Slocomb Co., Wilmington, Del., and Artisan Metal Products, Inc., Waltham, Mass. Marketing of the equipment will be handled by Artisan and Rainville Co., Garden City, N. Y., sales representative of F. F. Slocomb.

Polyox—a new water-soluble resin. Primarily used as thickening agents, water-soluble resins have shown a steady increase in volume for several years. A new one called Polyox has just been added to the list by Union Carbide Chemicals Co. It is a polymer of ethylene oxide, aptly called a "water-soluble polyethylene" by a Carbide spokesman. A cord the size of ordinary wrapping twine made from Polyox is so strong that it can't be broken by an average man's pull. A peculiar property of dry film made from this material is that it will take up very little moisture (0.3 to 3%) at normal humidity, but even at 95% humidity it maintains a dry, non-tacky surface. Yet in water it is claimed to have five times the solubility rate of polyvinyl alcohol and thus could become

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is available in *Resin or Compound Form* for electrical applications

VYGEN fits into your wire insulation production picture, regardless of size, equipment, or technique. VYGEN 120 for the operator doing his own compounding—VYGEN 6812 compound for the operator desiring a ready-to-extrude material—either one gives the very finest of finished products, and both are completely tested and UL-approved. So for the best in wire insulating material, specify the VYGEN made for your operation. And if technical service is necessary, just drop us a line.

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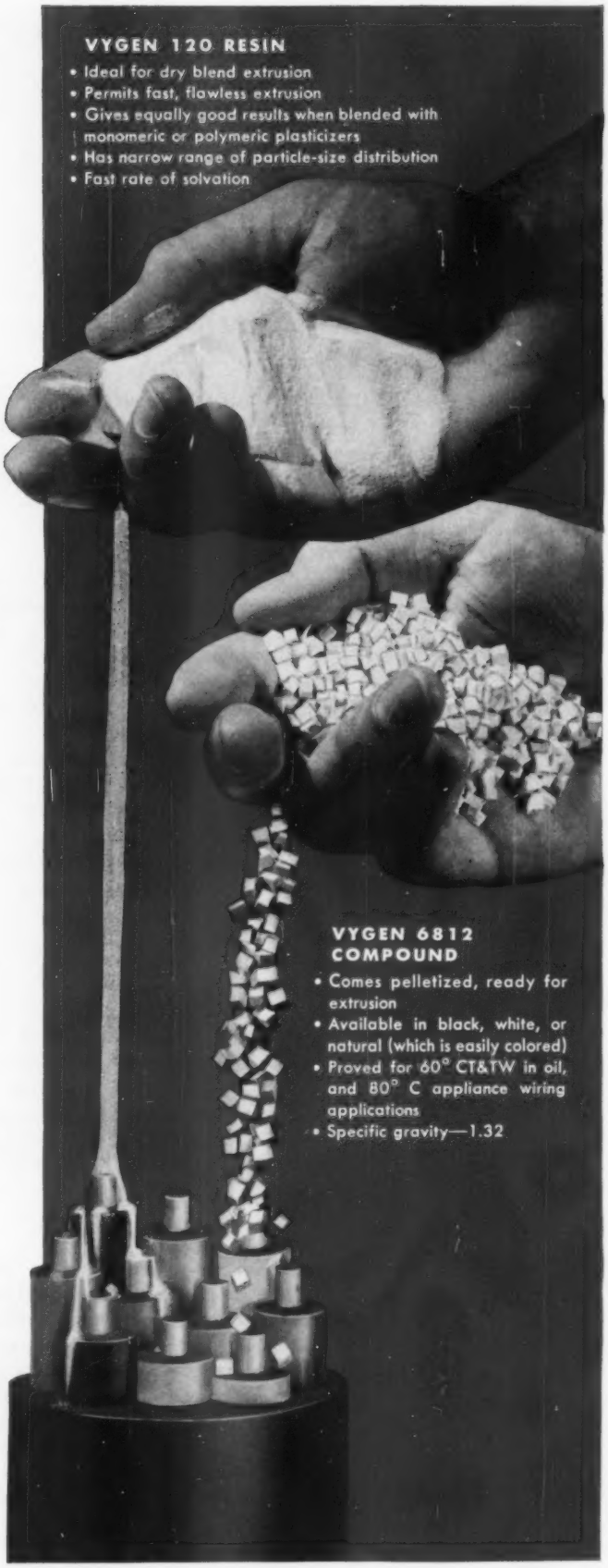

VYGEN 120 RESIN
• Ideal for dry blend extrusion
• Permits fast, flawless extrusion
• Gives equally good results when blended with monomeric or polymeric plasticizers
• Has narrow range of particle-size distribution
• Fast rate of solvation
VYGEN 6812 COMPOUND
• Comes pelletized, ready for extrusion
• Available in black, white, or natural (which is easily colored)
• Proved for 60° CT&TW in oil, and 80° C appliance wiring applications
• Specific gravity—1.32

The Plastiscope

(*Continued from page* 45)

an ideal package container for such items as soap, ink, paints, and agricultural chemicals when it is desirable to drop the contents into water and have the container dissolve without affecting the solution. Most water-soluble resins absorb 10 to 15% moisture.

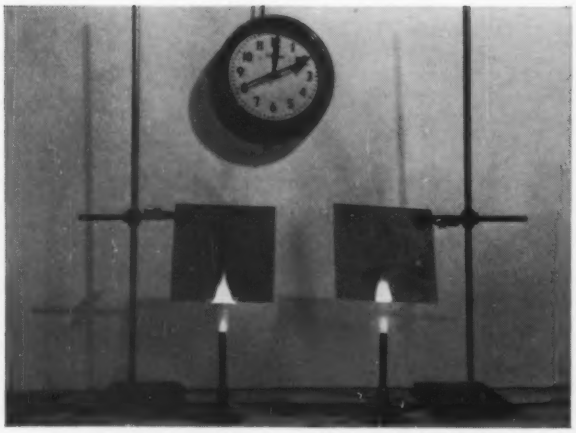
Polyox is claimed to be the only water-soluble resin, except polyvinyl alcohol, that can be calendered, extruded, or molded, but it does not require a plasticizer. A Polyox film can be heat-sealed by any type heat at from 100 to 200° C. Its grease resistance is such that it can make a fine paper coating where that property is needed, but, of course, it must be kept away from water. Ductility is its key property—it can be stretched or pulled like metal; but since it is a true thermoplastic and has plastics memory, it will return to its first form after heating.

Some uses other than those mentioned above are mold release films; warp sizing of cotton with ease of washing away the coating after weaving and no stream pollution arising after its disposal; temporary stiffening agent for textiles; thickening agent for cosmetics and toiletries, including hair spray; a binder for non-woven fabrics; binder for calamine lotions; aerosol-applied plastic bandages; adhesives; dip coatings; and scores of others.

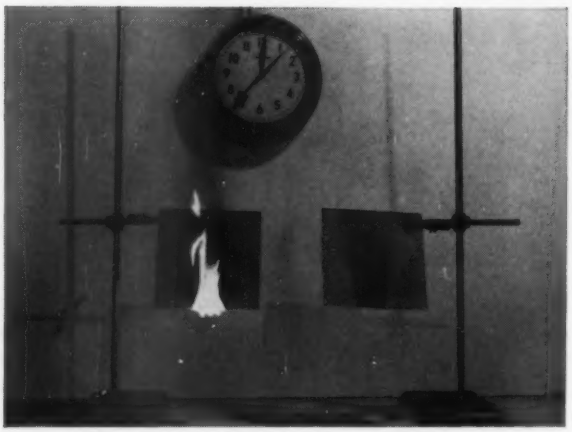
Nylon for weathering. A new nylon resin, Zytel 37X, which combines mechanical toughness with outstanding resistance to heat and weathering, has been developed by Du Pont. It is designed primarily as a wire jacketing material. Wide use is foreseen in power and communication cables, wire rope, service drop wire, and tree wire. As a molding material, it is suggested for automotive and electrical components, marine hardware, and sporting goods. Plastic Wire & Cable Corp., Jewett City, Conn., has made control cables jacketed with Zytel 37X for Du Pont's plant in Orange, Texas.

Polypropylene from Italy. According to Montecatini, that company's polypropylene, Mopien (L), will begin to appear on the American market next year in the form of household products, squeeze bottles, pipe and fittings, textile machinery parts, tape recorder housings, pump parts, and automotive parts. Mopien has a heat resistance of over 300° F. Presumably, either the products or the polymer will have to be imported from Italy if it is to show up in the United States in 1958 since no announcement has yet been made of facilities ready to start operation in this country.

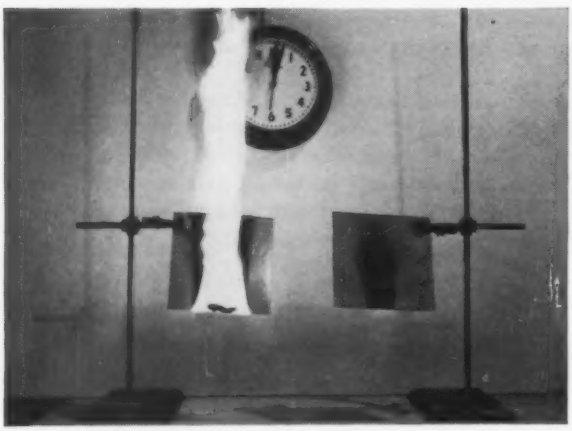
How to improve plastics statistics. Errors in reporting production and sales statistics to the Tariff Commission often result in frequent questioning of the Government's statistical reports on plastics sales. A good example is the "Styrene Resin" classification where it has been discovered that companies have been reporting inaccurately in the "protective coating" and "resins for all other uses" classifications to such an extent that previously published figures are almost useless since some companies report their "coating resins" under "other resins" and other companies do just the reverse. The total of the two is reasonably accurate, but up to now sales statistics reported under the "protective



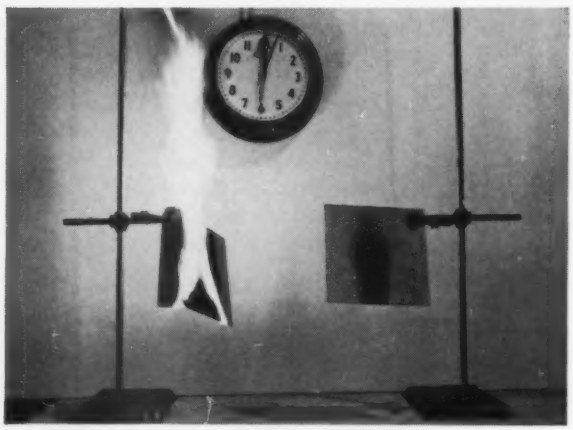
10 SECONDS Flame test contrasts epoxy laminates cured with conventional hardener (left) and with HET anhydride (right).



36 SECONDS Flame sources removed at 30 seconds. HET-cured laminate snuffs out instantly with local charring only.



2 MINUTES Conventional laminate continues to burn freely.



3 MINUTES Conventional laminate is almost totally destroyed.

Where can you use an epoxy that **resists flame?**

Your laminates and castings shrug off heat, moisture—even fire—when you cure with HET® anhydride

What could you do with

—a glass-reinforced epoxy laminate that keeps practically all its flexural strength *even when you heat it within the* 300-350°F range?

—an epoxy potting resin that retains its room-temperature electrical properties *at high humidities and at temperatures above 300°F*—and won't feed a fire?

These examples only hint at the amazing performance you can get when you use HET anhydride as a curing agent for your epoxy resins.

Conventional curing agents can't give you HET's combination of strength at high temperatures; fire resistance; high heat distortion temperature; good power factor and stable dielectric constant, both unaffected by moisture.

For easier casting or wet layup, you need not handle HET anhydride hot. You can mix it with another anhydride to form a curing system that *stays liquid at room temperature.* Also, HET anhydride has very low toxicity.

For complete information on HET anhydride, methods of use, and properties of cured resins, write on your business letterhead for Bulletins 19 and 43.

Plastics that fit the job

DUREZ® PLASTICS DIVISION

HOOKER ELECTROCHEMICAL COMPANY

3012 Walck Road, North Tonawanda, New York

HOOKER CHEMICALS PLASTICS

The Plastiscope

(*Continued from page* 47)

coatings" category have been too low, while sales figures given for "other resins" have been extremely high.

The reason for this confusion is the fact that the figures are often reported by the company's auditing division without consultation with the sales or market research department. Dow Chemical has made a constructive move to correct this trouble by appointing a coordinator whose task is to check production and sales figures sent in to the Government to make sure that each type of resin is reported in the proper classification. If other companies will follow this example, there will be less reason for a sales manager to get "bawled out" by management when his boss sees an inflated sales figure in the Government report and wants to know why his company isn't getting its share.

A new auto adopts a new plastic application. The new Edsel automobile is using a vinyl chloride plastisol and foam in a manner never before employed in automobiles. It is a large grommet-like fixture around the steering column at the spot where column, dashboard, direction indicator, and either automatic transmission or standard shift controls all come together. Other cars use several rubber grommets for these mechanisms, but the Edsel grommet is one piece of chemically blown foam covered with a plastisol ⅛-in. skin, produced in one piece by Sun Rubber Co. from Geon resins. Tolerances are, of course, extremely close. The grommet weighs about one pound.

Reinforced phenolic in cars, Phenolic-glass molding material is getting a foothold in the automotive industry, according to Fiberite Corp., Winona, Minn., one of the producers. Spokesmen assert that Chrysler already has several transmission parts made of the material, Ford has a number of development molds in the works, and Detroit Transmission, which supplies many of the major companies, is contemplating the use of about 12 parts in its transmissions. The ratio of phenolic to glass in this material is 50:50.

Alpha-methylstyrene. Hercules' alpha-methylstyrene is reportedly receiving considerable attention from producers of thermoplastics and thermosetting polyester resins. The advantage of using alpha-methylstyrene in thermoplastic copolymers is that it improves heat resistance. The heat distortion temperature of G-P polystyrene is about 82° C., but copolymers of alpha-methylstyrene and styrene can be made with heat distortion temperatures above 100° C.

Alpha-methylstyrene monomer can also be polymerized with butadiene, isoprene, maleic anhydride, acrylic acid, and acrylonitrile. The emulsion system is preferred where it can be used since rate and molecular weight can be more easily controlled.

The claim is made that when alpha-methylstyrene is used as part of the styrene constituent in a polyester formulation, it will slow down or control the rate of polymerization and reduce exotherm. The price is 14¢/lb., which is slightly more than conventional styrene monomer.

For additional and more detailed news see Section 2, starting on p. 258.

Flexible Resin !

PLEOGEN 1405

is a low cost, flexible polyester that can be used alone or blended with rigid resins to improve impact strength.

MOL-REZ makes it!

And MOL-REZ sells it for at least 4c per pound less than you'd expect to pay!

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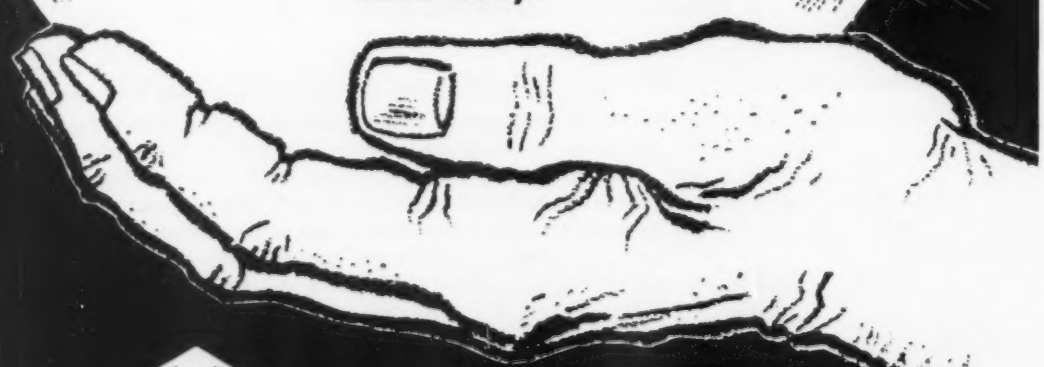

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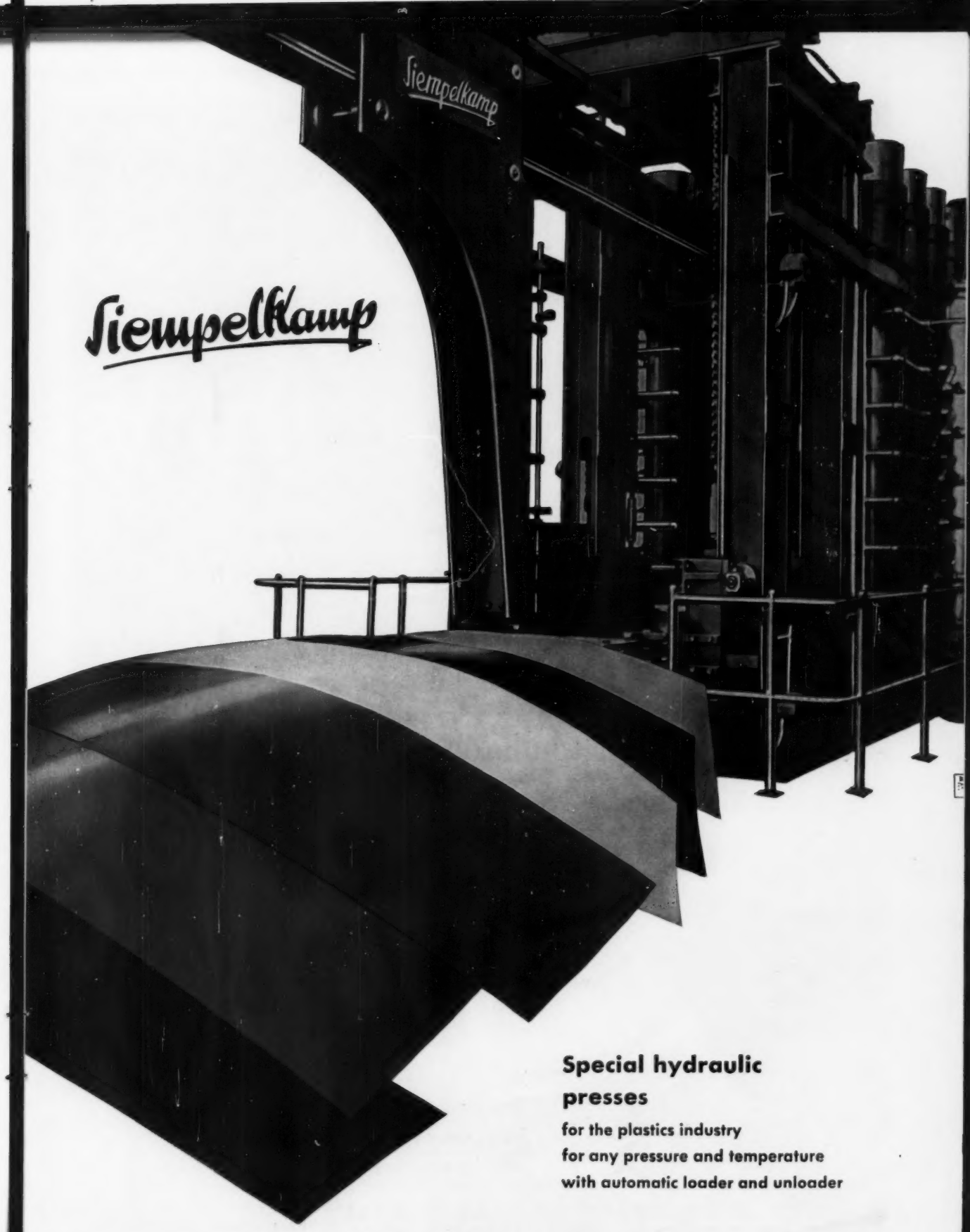

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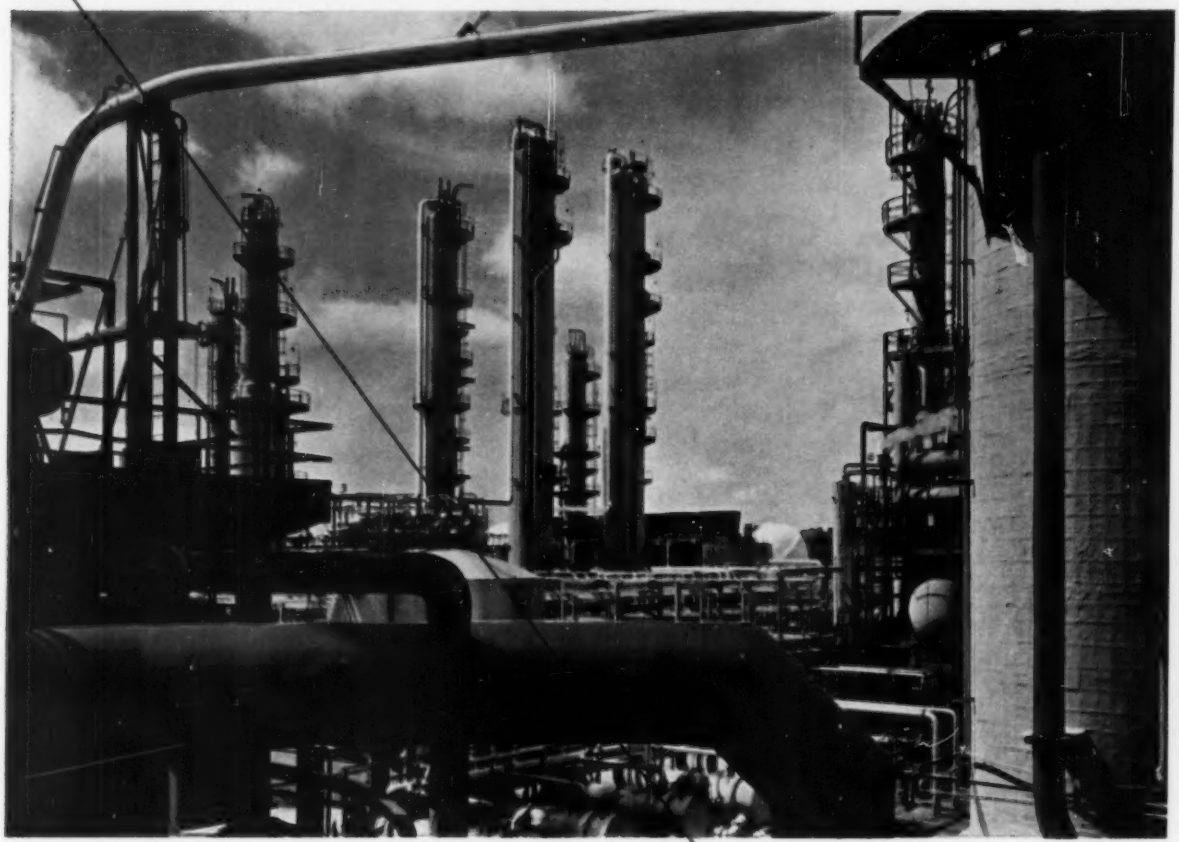
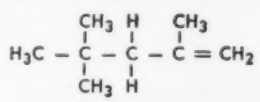
now—DIISOBUTYLENE for January 1958 delivery

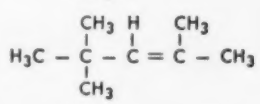


In January Petro-Tex will come on stream with substantial production of high-purity diisobutylene. Our commercial product will be a clear water-white 4 to 1 mixture of

2,4,4-trimethylpentene-1



and 2,4,4-trimethylpentene-2



with these physical properties:

Molecular Weight, average, calculated	112.1
Specific Gravity @ 60°F	0.720 – 0.722
Engler Distillation Range (@ 760 mm Hg)	
Initial	210°F (98.9°C)
90% point	218°F (103.3°C)
95% point	219°F (103.9°C)
Bromine Number	140
Sulfur Content, less than	60 ppm
Reid Vapor Pressure, psi	1.4

Uses include depolymerization to yield isobutylene
Alkylation with phenol toward production of surface active agents
Manufacture of nonyl alcohol by the oxo process

Working samples, detailed technical data and quotations will gladly be sent upon request to us at P. O. Box 2584, Houston 1, Texas.

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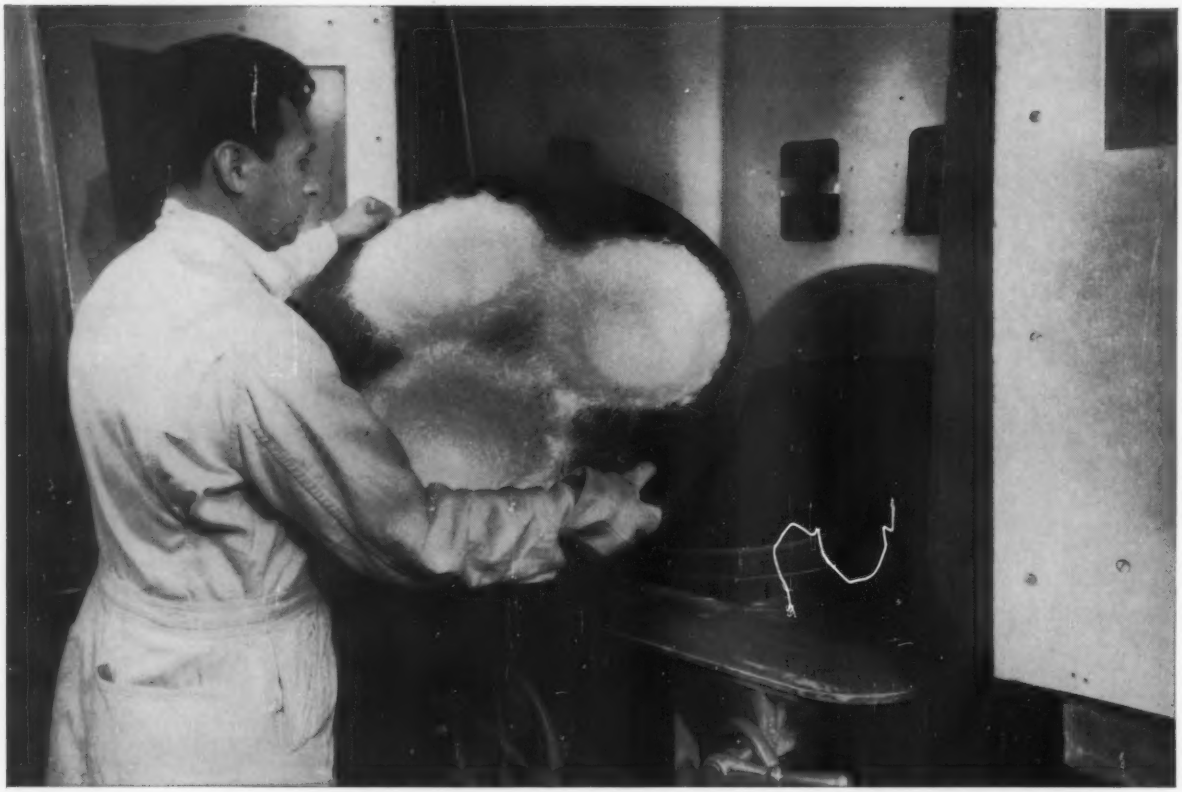

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2... with the right reinforcement for your needs

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3... and technical assistance

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Certainly, since we build calenders and related equipment, these clinics have been of great value to us. And because we believe that a free exchange of opinions and ideas is the surest way to promote progress and improvement in any industry, we extend to you and your company a cordial invitation to our conference room. Perhaps, like the famous riddle of which came first, the chicken or the egg, many questions will have to be left unanswered, yet the benefits to be derived from a free discussion of our common problems cannot fail to be mutually helpful.

Why not 'phone or write us for a conference date? The obligation will be all ours.

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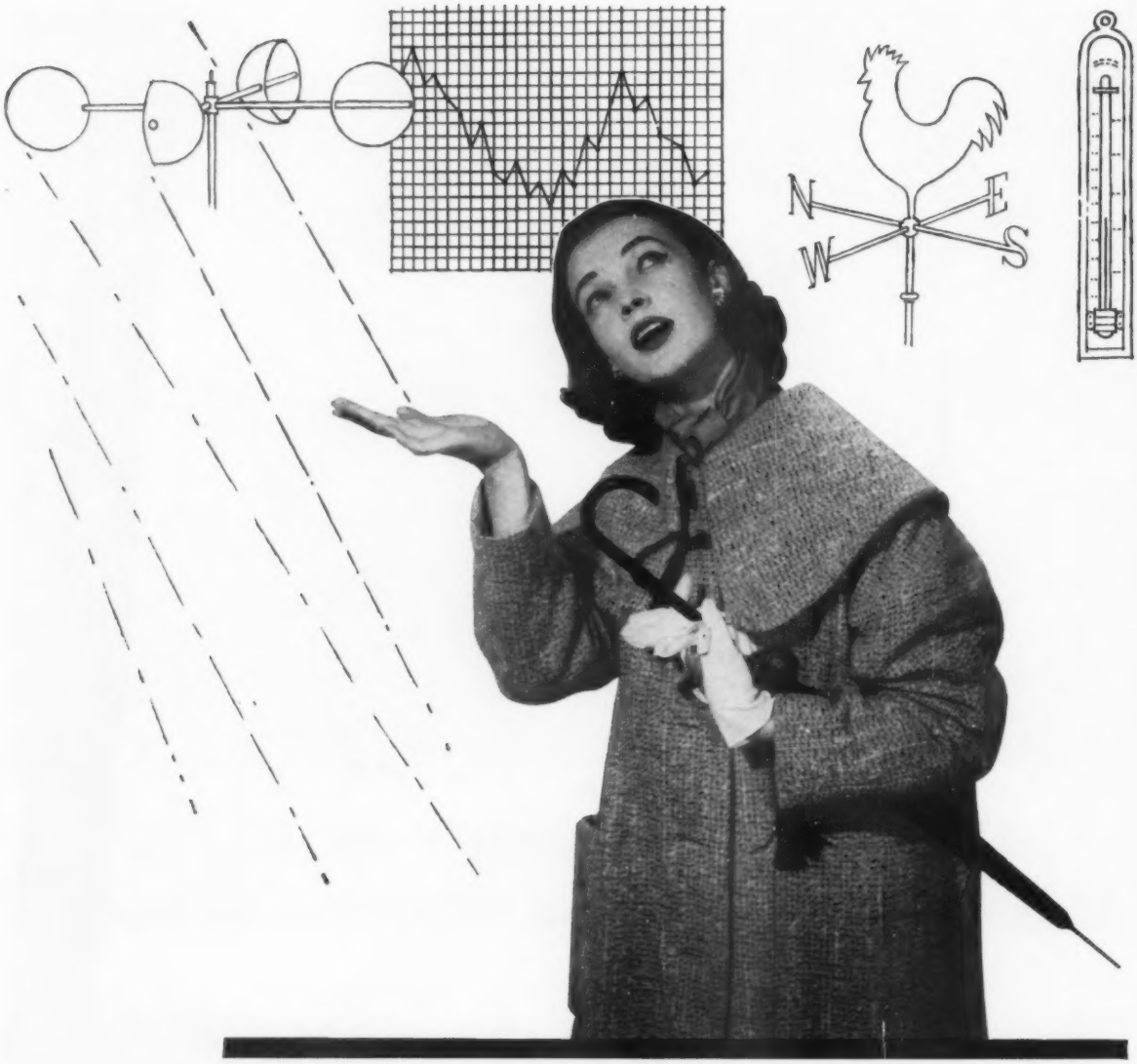

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At Kleestron we prefer to deal in the predictable — supplying the *accurate* answer to plastic moulders' needs. We've a range of injection moulding and extrusion materials to meet an endless variety of needs and circumstances, including yours in all probability.
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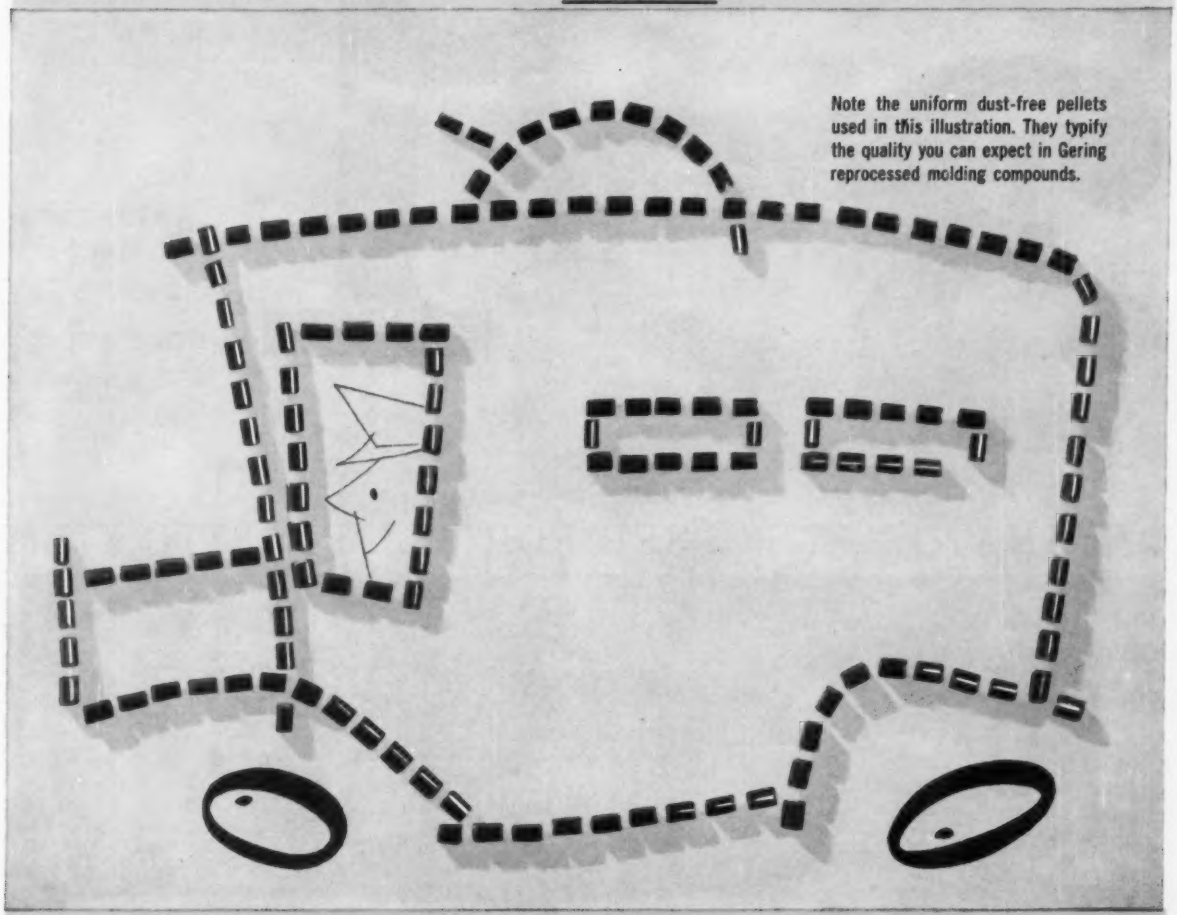

Note the uniform dust-free pellets used in this illustration. They typify the quality you can expect in Gering reprocessed molding compounds.

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SAVINGS

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For over 30 years, a continuous policy of individualized attention to customer needs has earned Gering its nationwide reputation for top-notch service.

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LAMINATES
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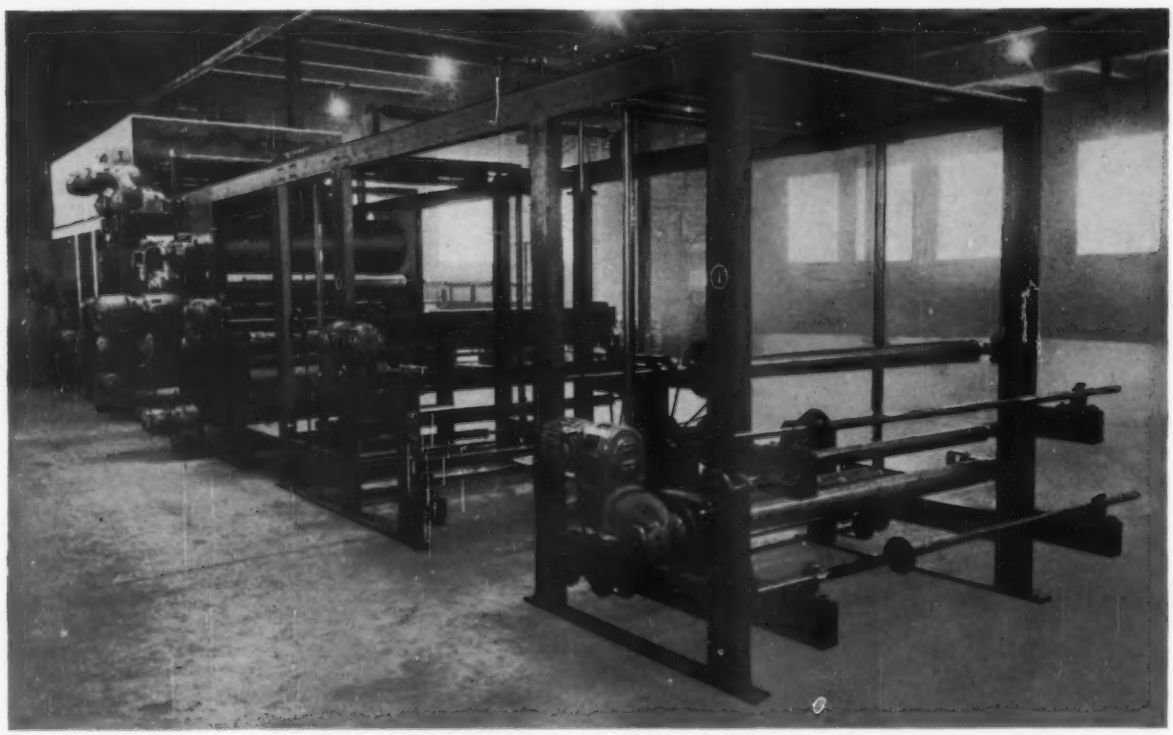
LAMINATOR-EMBOSSER FOR ALL PLASTIC FILM



Save time, power, labor. The new Lembo laminator-embosser permits single or multiple operations on all plastic film via selective power drives!

The new 3-2-1 offers all the advantages of the dependable Lembo triple-function machine *plus* the added benefit of eliminating waste operations. More compact and efficient, this laminator-embosser is tachometer-equipped at all critical work stations for the complete mechanical coordination that saves on stress. Call now. We shall be happy to arrange experimental runs for you.

The Lembo 3-2-1 LAMINATES stretch back or drills without adhesives,* EMBOSSES and VALLEY PRINTS to closest tolerances.

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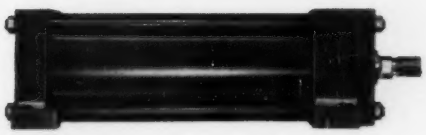

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What pictures cannot show you is the extra effort that goes into every Hannifin cylinder, all the way from the drawing board to the shipping dock. This brings you design features other cylinders simply do not have...superior workmanship where it's most needed for long, trouble-free service...and better delivery promises, better kept. All at prices no higher than you may have been paying for less satisfactory cylinders.

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AIR AND HYDRAULIC

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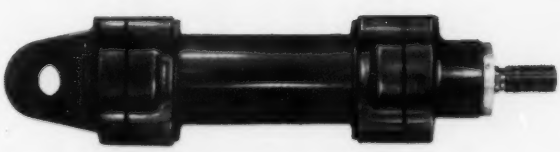

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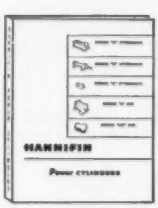

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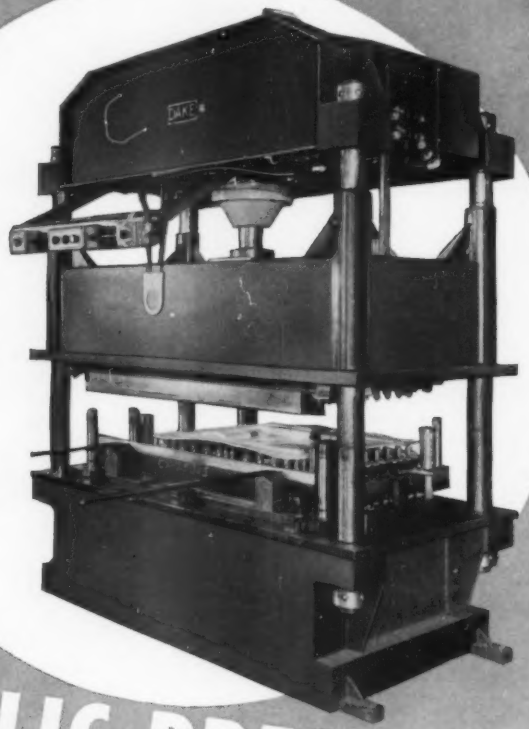
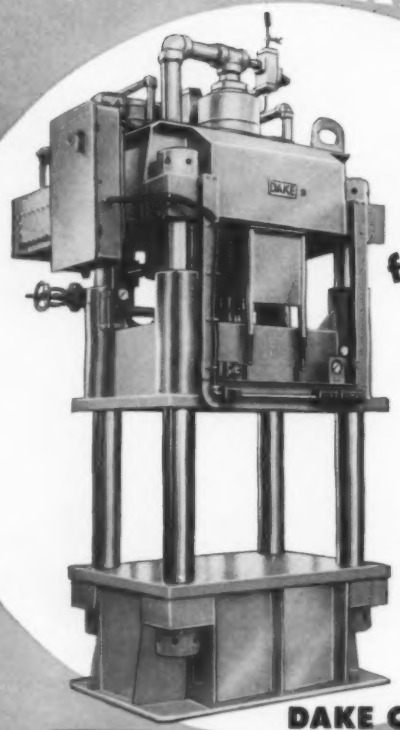


for trimming and piercing vacuum-formed plastics

DAKE HYDRAULIC PRESSES



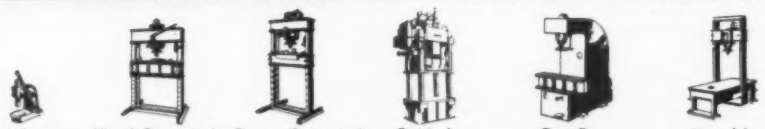
for molding reinforced plastics

Be a pacemaker in the fast-moving plastics industry with equipment designed to keep production geared to modern trends. Dake Hydraulic Presses speed output and reduce costs. They are job-engineered by men experienced in the plastics industry. These men are ready to help you meet special requirements as well as provide better equipment . . . both for compression molding of reinforced plastics as well as trimming and piercing vacuum-formed plastics. Standard models are electric-hydraulic in operation, with capacities ranging from 25 to 300 tons. They are adjustable for stroke, pressure, temperature and timing. Dual palm-operated controls are standard, providing safety in operation. Dake will gladly work with you in developing whatever special press equipment you need.

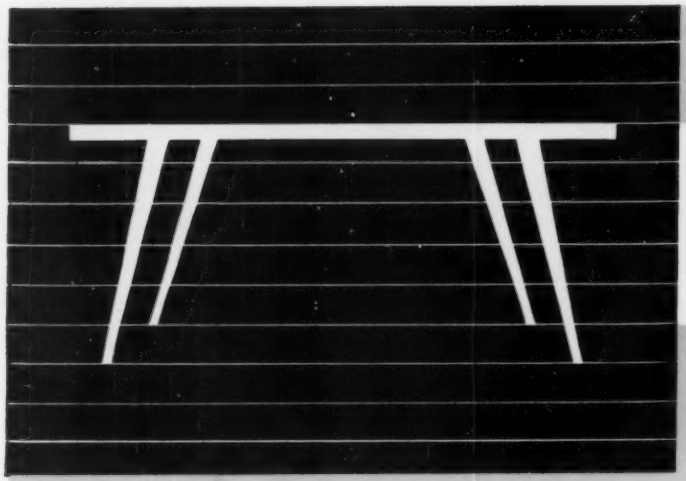
For descriptive literature on these presses, write for Bulletins 340 and 352.

DAKE CORPORATION 648 Seventh Ave., Grand Haven, Michigan

DAKE PRESSES



Arbor Presses | Hand-Operated Hydraulic | Power-Operated Hydraulic | Guided Platen | Gap Type Presses | Movable Frame



Melamine
is on top

in decorative
laminates

BRITISH OXYGEN CHEMICALS MAKE **Melamine!**

Melamine in
moulding powders

for today's tableware

British Oxygen Chemicals
supply Melamine to makers of resins and moulding powders for –

TABLEWARE

DECORATIVE LAMINATES

FABRICS

PAINTS

PAPERMAKING

British Oxygen Melamine
High assay
Uniform good colour on condensation
Uniform reaction time

BRITISH OXYGEN CHEMICALS, BRIDGEWATER HOUSE, ST. JAMES'S, LONDON S.W.1. ENGLAND

INCREASE PROFITS TWO WAYS

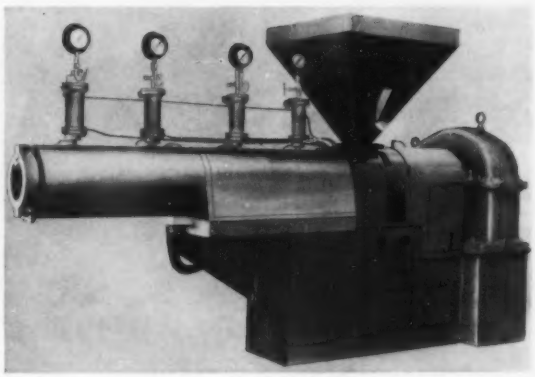
WITH A COMPLETE EGAN EXTRUSION INSTALLATION

1 *Lower manufacturing costs*

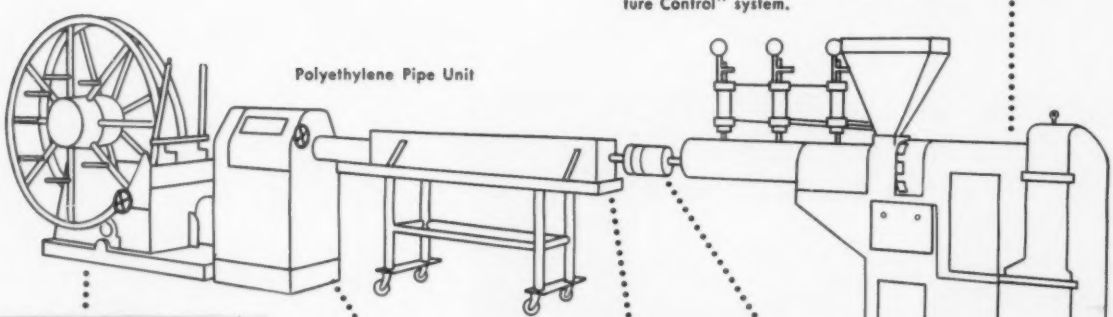
2 *Increase production runs*

The success story behind every Egan installation is the extruder proper. Egan Extruders with patented "Willert Temperature Control" systems provide automatic, balanced temperature levels, which result in closer tolerance extrusions with greater speed and ease.

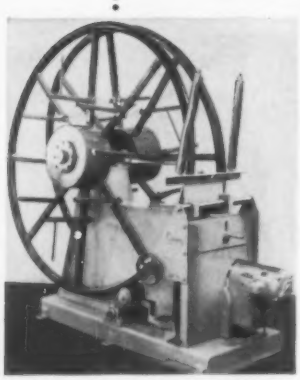
Complete extrusion installations or accessories available for pipe, film, sheet, shapes.



*EGAN EXTRUDERS: pre-set the temperature; "Willert Temperature Control" system takes over, providing completely automatic instrumentation.
*also available without "Willert Temperature Control" system.

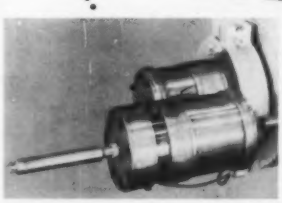


Polyethylene Pipe Unit



COILERS: dual reel type, with or without automatic level wind.

TAKE-OFFS: roller or multiple belt types in diameters of ½"—6" or 3"—14".



DIES: offset or straight-out, with or without extended mandrels.

COOLING TANKS: with vertical and horizontal adjustments.

FRANK W. *Egan* & COMPANY

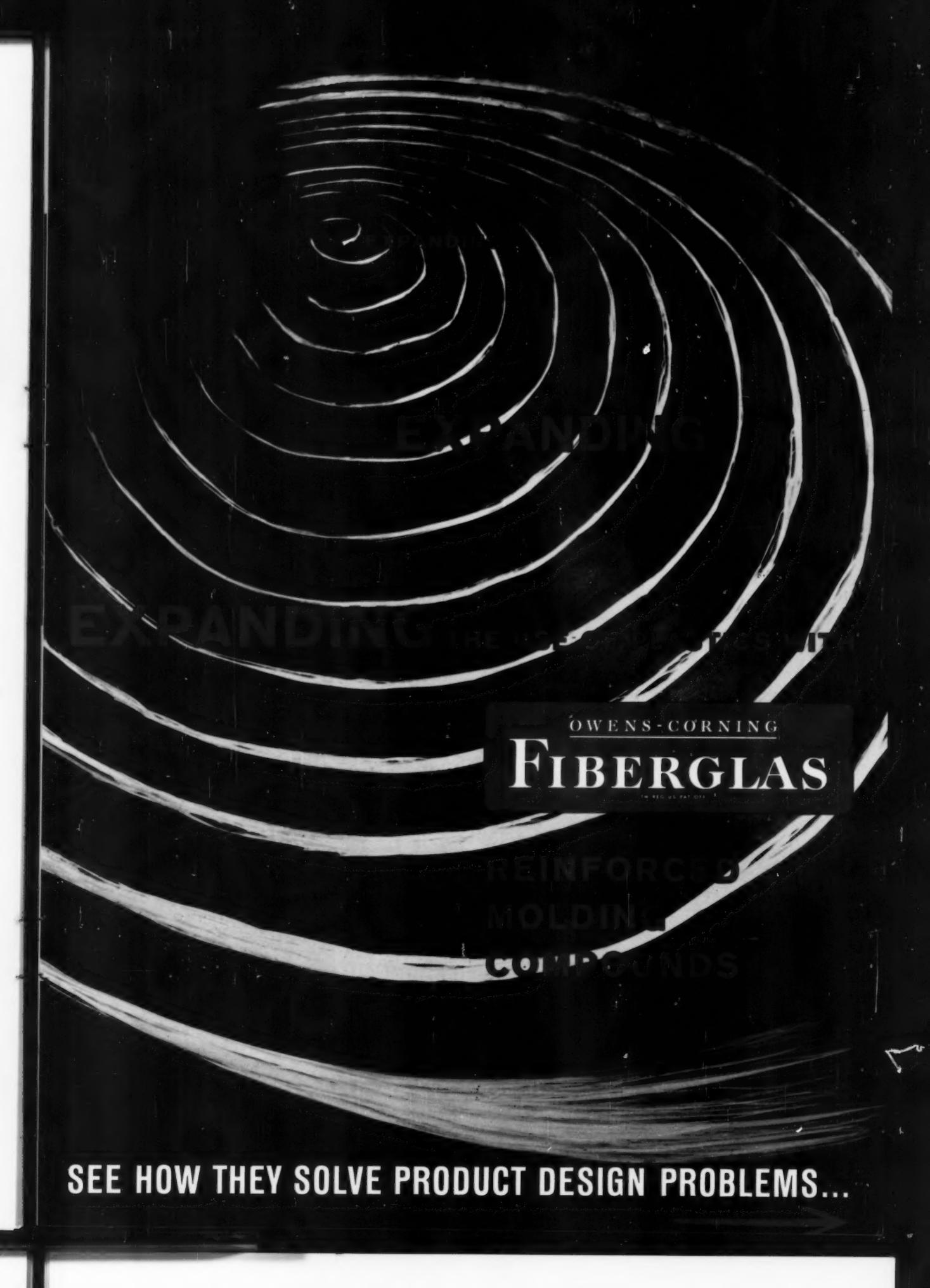
SOMERVILLE, NEW JERSEY

Manufacturers of plastics processing equipment

Cable Address: EGANCO — SOMERVILLE N.J.U.S.A.

Write, or Phone Randolph 2-0200
For Complete Information— No Obligation.

REPRESENTATIVES: MEXICO, D.F.—M.H. GOTTFRIED, AVENIDA 16 DE SEPTIEMBRE, NO. 10. JAPAN—CHUGAI BOYEKI CO., TOKYO. **LICENSEE:** GREAT BRITAIN—BONE BROS. LTD., WEMBLEY, MIDDLESEX.



SEE HOW THEY SOLVE PRODUCT DESIGN PROBLEMS...

ALL THE PROPERTIES OF PLASTICS...PLUS

✚ Heat Resistance
✚ Strength
✚ Dimensional Stability

Strong support for armless "VENUS"

VENUS is the appropriate brand-name of this ingenious new portable phonograph with no visible tone arm. The record is played on the *bottom* side by a tone arm which is out of sight and safe from damage.

This unique design calls for a top plate which serves as the prime structural member. The material chosen for this part had to be light in weight . . . resistant to heat . . . and strong enough to support the motor, amplifier and speaker. Designers found the perfect answer in Fiberglas*-reinforced polystyrene molding compound. The intricate part is mass produced by the fast and economical injection process. The finished polystyrene part is notable for its attractive molded-in color and fine surface finish — features which contribute to the final sale of the phonograph.

Where a design calls for both good appearance *and* performance at a low cost, the ideal solution will often be found in the realm of Fiberglas-reinforced molding compounds.

DESIGNER AND PRODUCT MANUFACTURER: *Molded Insulation Co., Philadelphia 44, Pa.*

MOLDER: *Molded Insulation Co.*

MOLDING COMPOUND: *Fiberglas-reinforced polystyrene by Fiberfil, Inc., Warsaw, Indiana.*

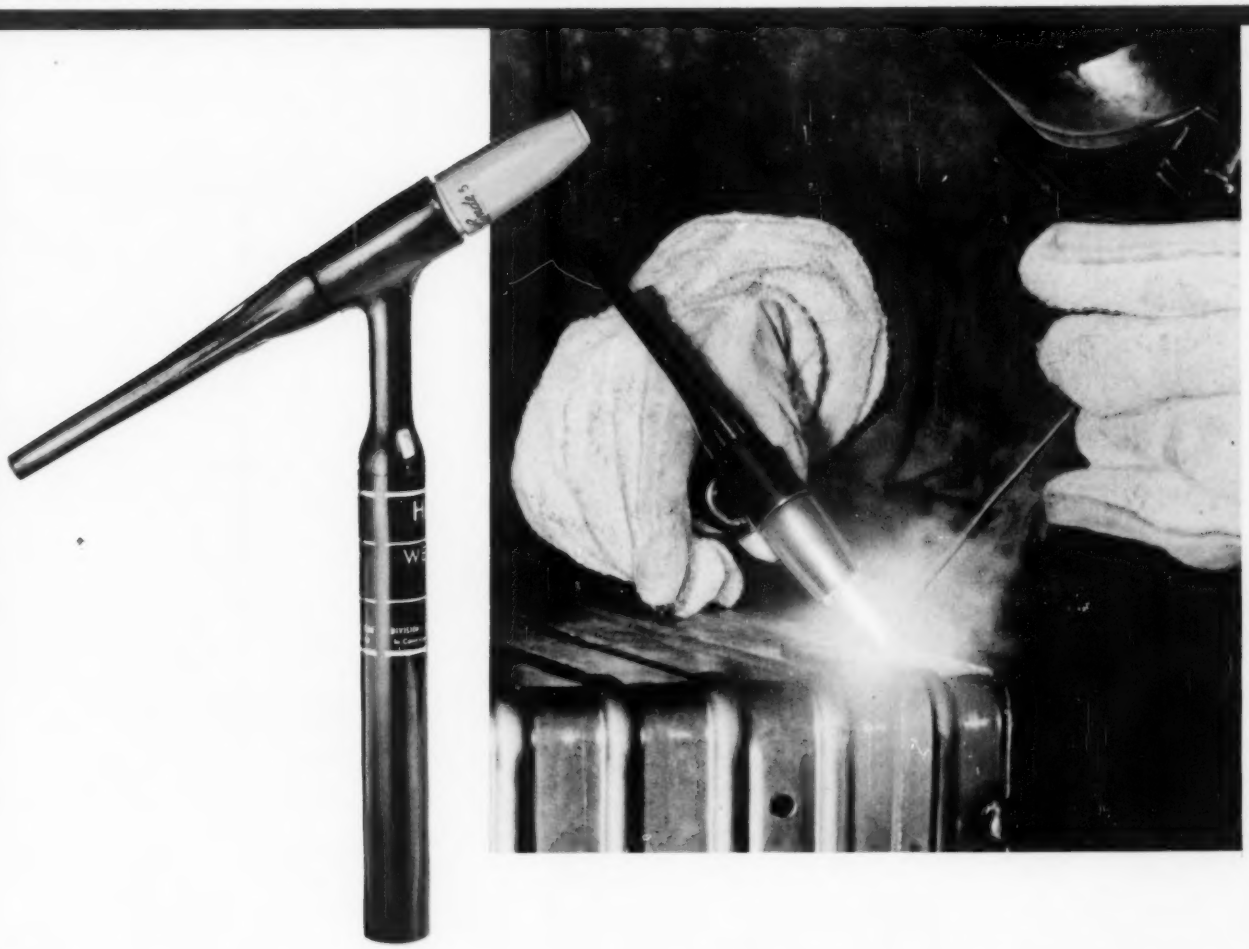
OWENS-CORNING
FIBERGLAS

REINFORCED

*T-M. (Reg. U.S. Pat. Off.) O-C.F. Corp.

PLASTIC MOLDING COMPOUNDS with Fiberglas reinforcement have surmounted many of the limitations which molded plastics impose on the designer. For Fiberglas-reinforced molding compounds make products that are far stronger . . . more resistant to temperature extremes . . . with better dimensional tolerances and stability than have ever before been possible. In effect, they are opening up a whole new world of design opportunities.

Yet Fiberglas-reinforced molding compounds have all the good properties, processing advantages and economies you associate with molded plastics. They're formed in standard transfer, injection or compression molding equipment and introduce no new problems in handling or processing. On these pages, you see a few of the many new products designed with Fiberglas-reinforced molding compounds to attain all the properties of plastics . . . plus!



Bed of fire under a gas blanket

Linde designers faced an imposing combination of severe requirements when they selected a material for this high-speed inert gas tungsten arc welding torch. Used for welding of ferrous and non-ferrous metals under a shield of argon gas, the torch operates at continuous temperatures of 500°F, with intermittent service running even higher. So the material chosen had to have exceptional heat resistance plus high impact strength for heavy usage. Add a vital need for exceptional dimensional stability and high dielectric insulating properties —and the specifications become even more difficult to meet.

One and only one material could fill all these requirements —Fiberglas-reinforced phenolic molding compound. With this material, the complicated internal bores of the two parts can be molded around complex inserts by the standard transfer process. With phenomenal heat resistance, high dielectric strength, and a good dissipation factor, Fiberglas-reinforced phenolic has proved the perfect choice for this gas-blanket welding torch. It's the toughest, most durable and effective torch of its kind ever made.

PRODUCT MANUFACTURER: *Linde Company Division of Union Carbide Corp., New York, N. Y.*

MOLDER: *Star-Glo Plastics and Rubber Molding Co., North Arlington, N. J.*

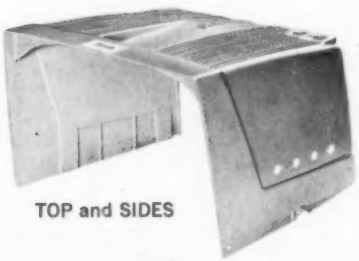
MOLDING COMPOUND: *Fiberglas-reinforced phenolic by Fiberite Corp., Winona, Minnesota.*

MOLDING COMPOUNDS→

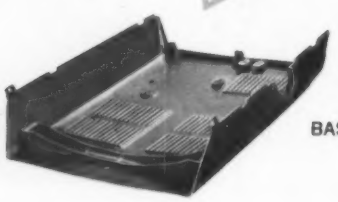
ALL THE PROPERTIES OF PLASTICS... PLUS

✚ Heat Resistance
✚ Strength
✚ Dimensional Stability

BACK



TOP and SIDES



BASE

New Silvertone lightweight cabinet gives TV a lift

A portable TV set presents an interesting design problem. Every component must be as light as possible, yet possess sufficient shock resistance to withstand rugged use. The cabinet, in particular, must possess high impact strength and rigidity along with light weight. And the fabrication method must permit high production rate of a complex shape at low cost.

Designers of this Silvertone portable solved the whole problem neatly with Fiberglas-reinforced polyester molding compound. The cabinet was designed in three molded parts, which can be produced rapidly and assembled into the finished cabinet economically. The new Silvertone cabinet is light and durable, with attractive molded-in color and—as an added safety bonus—its high dielectric strength cuts down the danger of electric shock.

Cabinets and housings of all kinds—with high strength and permanent quality—are increasingly coming into the design province of Fiberglas-reinforced molding compounds.

END USER: *Sears, Roebuck & Co.*

PRODUCT DESIGNER AND MANUFACTURER: *Warwick Manufacturing Co., Chicago, Ill.*

MOLDER: *General American Transportation Corp., Chicago, Ill.*

MOLDING COMPOUND: *Fiberglas-reinforced polyester*

THE CASE HISTORIES on these pages illustrate just a few of the thousands of products which have been profitably fabricated with Fiberglas-reinforced molding compounds. **Write now for our complete file of case histories and a list of suppliers of Fiberglas-reinforced molding compounds.**

OWENS-CORNING
FIBERGLAS

TEXTILE PRODUCTS DIVISION
Dept.125-L, 598 Madison Ave., N.Y. 22, N.Y.

Owens-Corning Fiberglas Corporation produces only the reinforcement for the manufacturers of reinforced molding compounds.

Merry
Christmas
from all of us
at
COLUMBIAN
CARBON
COMPANY
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COMPANY

The NRM you buy today will still be modern years from now

NRM 3½" Electrically Heated Model 55 Extruder with Handy Clamp Die Head

Here's why—

Consider what's behind NRM Extruders . . . creative engineering, aggressive development and the finest in manufacturing methods and skills . . . This is the combination that enables NRM owners to "plan ahead" for company growth, knowing the NRM's purchased now will still be modern—and making money—years from now.

CREATIVE ENGINEERING

NRM gave the plastics industry the first extruder designed specifically for thermoplastics, and has *kept* NRM Extruders "years ahead" in design by bringing out important advancements, one after the other. Just a few are: electric heating, balanced heat control, torpedo feed screws, long cylinder ratios and automatic die head clamps. Others, on the drafting boards today, will be coming up for you in 1958.

CONTINUING RESEARCH AND DEVELOPMENT

. . . It is a *ceaseless* activity at NRM, and it's why you can count on NRM Extruders for "tomorrow's engineering advantages *today!*" It constantly probes for "the better way" to extrude thermoplastics, and immediately incorporates proven developments as *standard* NRM features. Here a new type die for *continuous* extrusion of PVC plastic sheet is being tested in the NRM research laboratory.

2877

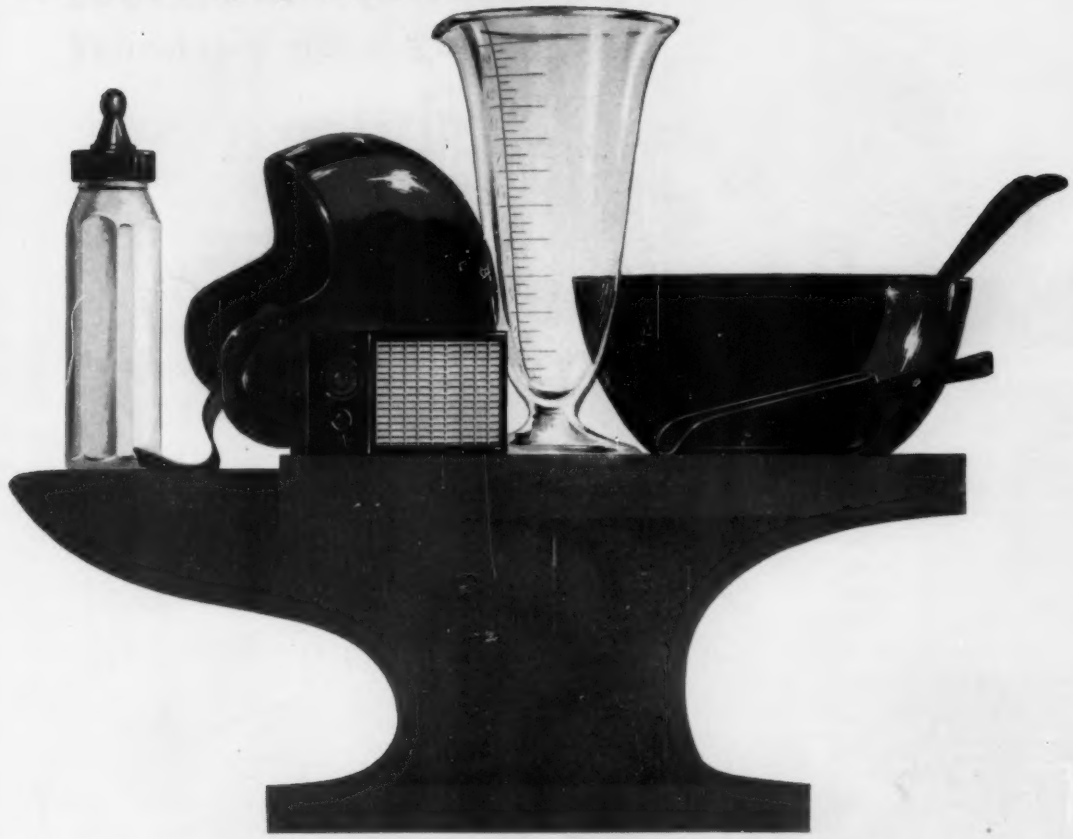
NATIONAL RUBBER MACHINERY COMPANY

NRM

Creative Engineering

General Offices and Engineering Laboratories: 47 West Exchange St., Akron 8, Ohio
EASTERN PLANT: 384 Getty Ave., Clifton, N. J.
SOUTH: The Robertson Company, Rutland Building, Decatur, Ga.
WEST: S. M. Kipp, Box 441, Pasadena 18, Cal.
MID-WEST: National Rubber Machinery Company, 5875 N. Lincoln Ave., Chicago 45, Ill.
CANADIAN: F. F. Barber Machinery, Ltd., 187 Fleet St., West, Toronto, Ont.
EXPORT: Omni Products Corporation, 460 Fourth Ave., New York, N. Y.

For sturdy plastics...



switch to high strength

GREX*

GREX, new high density polyethylene, offers a combination of vastly improved properties that broadens sales potential for plastic fabricators and their customers as well.

For example, GREX brings to industrial moldings impact and tensile strength far superior to many costlier molding materials. GREX-made hospital items that require sterilization and chemical cleaning, won't wilt, stay like new. In refrigerator containers and trays, GREX stays brittle-free, demonstrating resistance to extreme cold. GREX makes top-grade electrical insulation. Film made from GREX features good 'slip' and is suitable for high speed packaging. It is easily heat sealed and is an effective moisture barrier.

Toughness, durability, boilability—learn how these and other improved properties of GREX can help *you* turn out better made, faster selling plastics! Mail the coupon today!

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POLYMER CHEMICALS DIVISION

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W. R. GRACE & CO., POLYMER CHEMICALS DIVISION, DEPT. 94
225 Allwood Road, Clifton, New Jersey

Please send more information about new GREX plastic.

I am interested in these uses:.....

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NAME.....TITLE.....

COMPANY.....

ADDRESS.....

CITY.....STATE.....

From sturdy fishing rods to handy soup kitchens!

Pittsburgh Selectron

POLYESTER RESINS

Now Ready For A Thousand New Uses

PITTSBURGH SELECTRON Resins have opened new opportunities for much greater product usefulness with reduced manufacturing costs.

When combined with suitable fillers these remarkable resins have been used to mold products that are lighter than aluminum with strength-weight ratios and impact resistance surpassing those of any other known materials. They also provide unusual resistance to weather, sunlight, heat, abrasion and many chemicals.

That's why SELECTRON Resins are today being used in a wide range of products. These can be as different in size, shape and weight as the new "glass" fishing rods so popular among anglers and the modern displays used in Heinz Fast-Food Kitchens. These displays were designed by the Milwaukee Industrial Designers, of Milwaukee, Wisconsin, and molded by G. B. Lewis, of Watertown, Wisconsin.

SELECTRON Resins are of the thermo-setting type. They polymerize to form solids with or without heat and with or without pressure. Parts in which they are used can be molded either by hand lay-up, direct molding, continuous lamination or pre-forming. These resins can also be used without fibers for casting, potting and impregnating.

We'll be glad to have one of our engineers discuss your problems with you without cost or obligation. This may save you time and money.

Send For FREE Booklet!

Write, wire or phone today for our new booklet containing descriptions of SELECTRON Resins and explaining many of the ways in which they can be used. Pittsburgh Plate Glass Company, Selectron Products Division, Gateway Center, Pittsburgh, Pa.

Just a few products in which Pittsburgh SELECTRON Resins are now used—

Aircraft structural parts
Radomes for electronic equipment
Life floats
Ballistic panels
Helmets
Boat hulls
Machinery housing and guards
Trays
Tote boxes
Food lockers
Garbage pails
Baskets for automatic dishwashers
Baskets for automatic washers
Wash tubs
Tool chests
Shipping containers
Instrument cases
Laundry hampers
Kitchen containers
Fishing rods
Sinks
Street signs
Traffic signs
Fluorescent light fixtures
Television cabinets
Loudspeaker housings
Gas meter housings
Structural panels for offices and homes
Door and transom lights
Awnings and canopies
Greenhouse panels
Skylighting
Molded chairs
Prefabricated houses and garages
Truck bodies

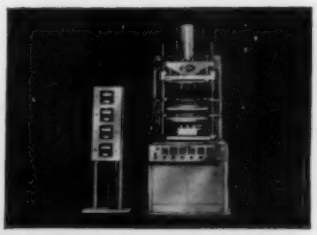
PITTSBURGH Selectron

PAINTS • GLASS • CHEMICALS • BRUSHES • PLASTICS • FIBER GLASS

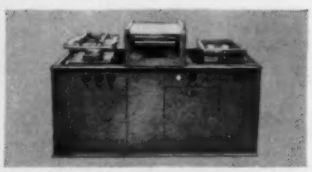
PITTSBURGH PLATE GLASS COMPANY

IN CANADA: CANADIAN PITTSBURGH INDUSTRIES LIMITED

Reduces machine investment, tooling costs, by more than 50%



VAC-TRIM combines straight vacuum, drape and plug forming—plus automatic trimming—in a single machine. Saves equipment costs, labor, floor space. Push-button operation. Complete flow-control system.



VacForm 88FM is a compact, versatile machine arranged for both drape and straight vacuum forming. Maximum mold size, 16½" x 16½". Manual and semi-automatic controls.

VacForm "GIANT" is world's largest vacuum forming unit. This model, engineered and built to National Broadcasting Company specifications, has a forming area 12' long and 6' wide, is used for low cost three-dimensional TV scenic elements. Comparable models built to special order for a wide range of special applications.

VacForm equipment costs substantially less than comparable plastic molding equipment, both in terms of original investment and tooling costs.

It can also give you increased production, lower costs and a broader range of end products. VacForm uses inexpensive molds... reduces retooling "down time" to a minimum... works with more types of plastics... requires minimum maintenance.

VACFORM

PLASTIC FORMING MACHINERY

EMHART MANUFACTURING COMPANY

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Write for new informative booklets.

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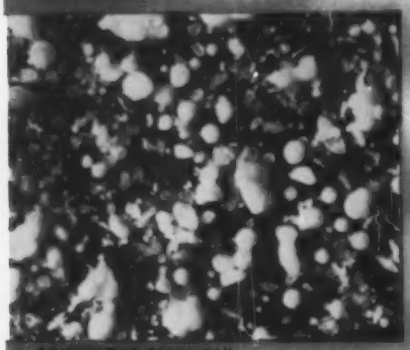
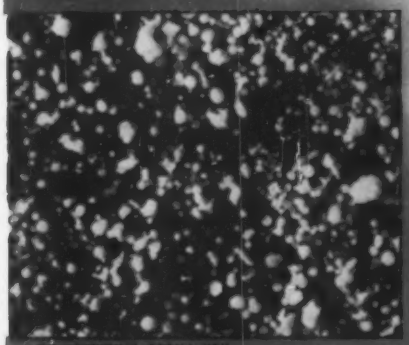
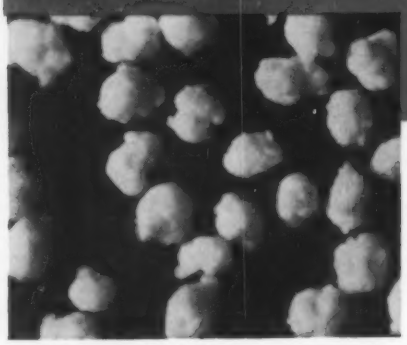
P-1257



COMPETITIVE RESIN "A"



COMPETITIVE RESIN "B"



ESCAMBIA PVC RESIN

*In the photomicrographs shown above, the resins have been magnified 40 times.

no "dust storms"

with ESCAMBIA PVC

You eliminate "dust storms" in your plant with Escambia PVC because these resins are extremely low in fines as these photomicrographs* show.

With Escambia you also get freer-flowing hot pre-mixes, lower "fish eye" count, better heat stability and improved color uniformity and clarity.

Prove these unique advantages in your own plant with a test run of the Escambia PVC resin best suited to your operation:

ESCAMBIA PVC 1250 — High molecular weight resin, recommended for dry blend extrusion of shapes and profiles and for calendered film.

ESCAMBIA PVC 1225 — The inherent heat stability of this intermediate molecular weight resin gives properties comparable to those usually associated with higher molecular weight PVC.

ESCAMBIA PVC 1200 — Lowest molecular weight in this series with outstanding heat stability not generally associated with resins of this molecular weight. It is recommended for calendering, extrusion and molding when lower processing temperatures are required.

NEED A SPECIAL TYPE PVC? *Your needs for a special type of PVC will get prompt attention at Escambia. The answer to your production problem may be among the many types of specialty PVC's developed by Escambia's research department: modified and unmodified low molecular weight PVC, conventional and novel copolymers, PVC's for various rigid applications and others. Direct your inquiries to the address below.*

For additional information about Escambia's PVC resins — write or call —

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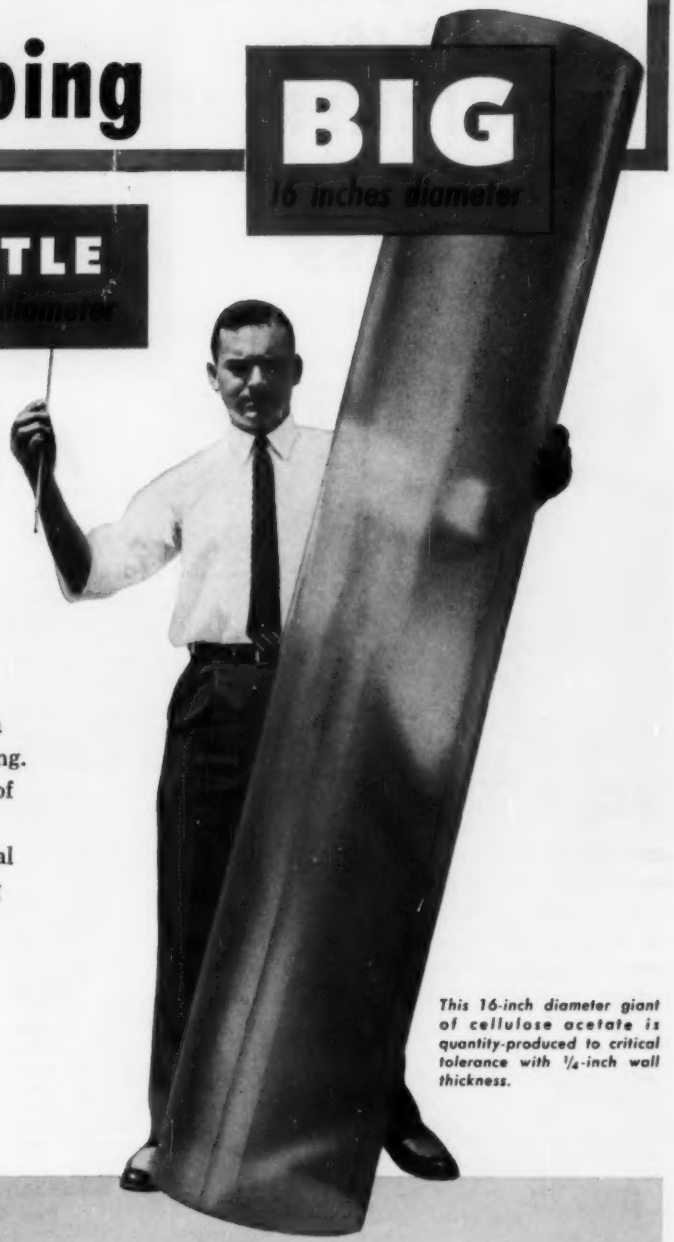
if you need

Plastic Tubing

BIG
16 inches diameter

LITTLE
⅛-inch diameter



flexible or rigid...
consult **YARDLEY**

In any size — from diameters of ⅛ inch through 16 inches — Yardley has proved a dependable and economical source of tubing. Extruder facilities with annual capacity of over 10,000,000 pounds, plus the right materials, skilled engineering and personal attention — all are yours when you bring your extrusion problems to Yardley.

This 16-inch diameter giant of cellulose acetate is quantity-produced to critical tolerance with ¼-inch wall thickness.

These materials:

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Rigid and Elastomeric Vinyl • Acrylic
Cellulose Acetate • Cellulose Butyrate
Kralastic • Styrene • Nylon • Cycolac

Our complete tool and die shop is staffed with skilled technicians. In addition, we maintain a library of over 300 section dies, one of which may fit your product design.

YARDLEY

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DESIGN • EXTRUSION • FABRICATION

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I am interested in learning how you can help us find better ways to solve our extruded parts problems.

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Company_____
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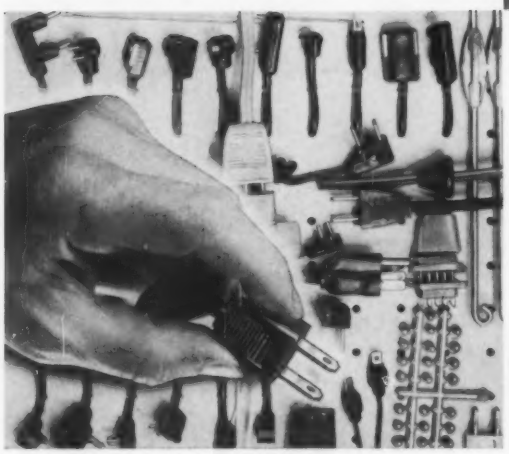
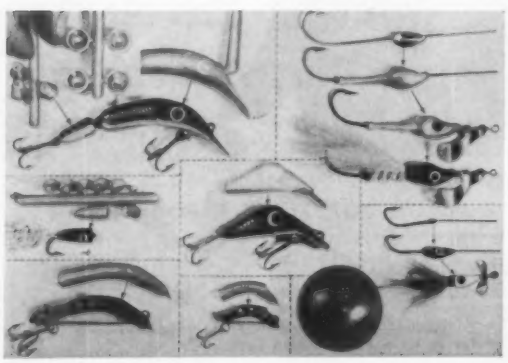
Position_____

MOLD 'EM QUICKER* BETTER* FOR LESS* on . . .



MINI-JECTOR cuts costs for manufacturers of electrical, electronics, industrial, and commercial equipment. Wide variety (above right), MINI-JECTOR produced, represents major savings in big-press tooling where not required. Electrical and electronics parts (above) made for less on MINI-JECTOR: plugs, cord-ends, antennas, miniature brush ass'ys, slip rings, etc.



MINI-JECTOR cuts costs for specialty makers of toys, accessories, novelties, etc. MINI-JECTOR produced Oster baits (above) win "quality" award of Sportsmen's Clubs of America. Oster claims, "MINI-JECTOR makes 'em better at fraction of former cost. Thousands marketed *before* big-press tooling can be designed."

MINI-JECTOR®

Reg. U.S. Pat. Off.

PLASTIC INJECTION MOLDING MACHINES

***Quicker:** Produce thousands of molded items before "big-press" tooling is off design board.*

***Better:** Award-winning quality and precision even in complex, "insert" molded designs.*

***For Less:** Develop and produce molded items at fraction of "big-press" tooling costs.*

You can save *actual thousands* in mold costs alone with MINI-JECTOR! (Mold-blanks as low as $29.50.) Others are doing it—avoiding big-press "high-per-piece" tooling expense where not required.

Only MINI-JECTOR offers so many exclusive features:

- . . . for quicker, lower-cost development and steady, moderate production of variety small (1/3 oz. to 1 oz.) plastic items in all thermoplastics, including Nylon.
- . . . for quick design changes; and running thousands of perfect mark[illegible]st samples.
- . . . for specialty items and plastic molding over inserts—from intricate electronic parts to baits, novelties, etc.; marketed quicker.
- . . . for laboratory and educational test-sample design and production—quick thousands of perfect parts in variety of colors. No lost changeover time.
- . . . for short or moderate runs—too costly on big-presses—profitable on MINI-JECTOR.

Send for FREE Catalog—Detailed, illustrated, complete. Engineering data and specifications on entire low-cost MINI-JECTOR line of plastic injection molding machines and accessories. Many features superior to most expensive machines. Shows how MINI-JECTOR helps you develop and produce 1/3 oz. to 1 oz. molded plastic items more profitably than by other methods.

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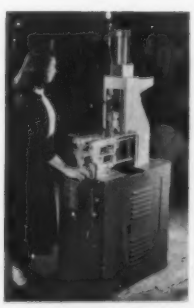
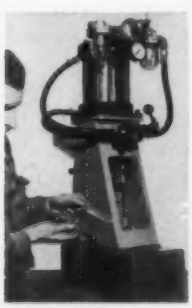
Box 388, Newbury, Ohio



Model 60 Super "Hornet"
Hydraulic-operated, lever-controlled.

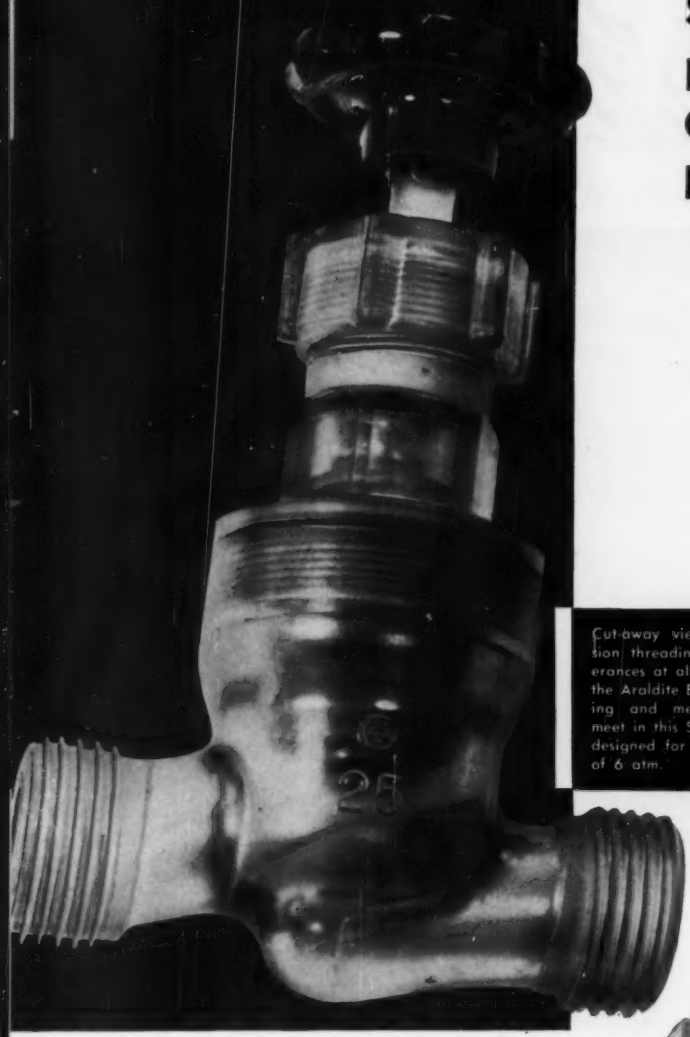


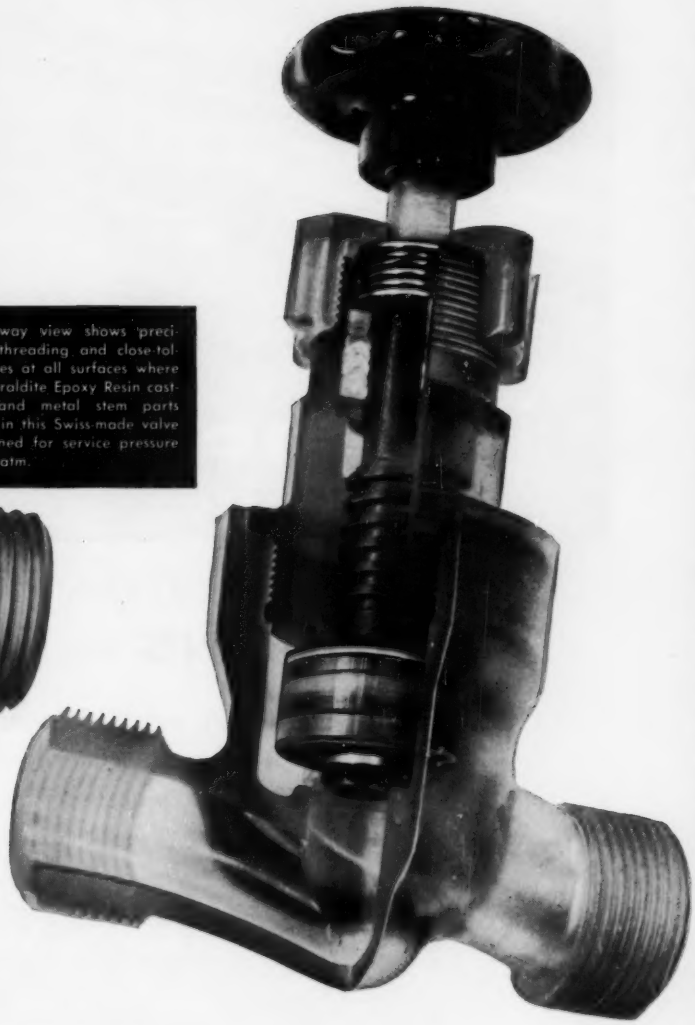
Model 45 "Wasp" (bench)
Air-operated, lever-controlled.

Model 50 "air-JET" Wasp
Air, push-button controlled.

IDEAS IN THE MAKING WITH
CIBA ARALDITE EPOXY RESINS

. . . Mass-produced STRAIGHTWAY VALVE precision-cast in CIBA Araldite® Epoxy-based resin





Cut-away view shows precision threading and close tolerances at all surfaces where the Araldite Epoxy Resin casting and metal stem parts meet in this Swiss-made valve designed for service pressure of 6 atm.

High strength, dimensional stability, corrosion resistance, ready conformity to precision design specifications enable Araldite Epoxy Resins to bring both new looks and new efficiency on a low cost multi-unit production basis to an ever-increasing range of industrial and household equipment. To learn more about the new era of product design emancipation that Araldite Epoxy Resins are pioneering, check in the coupon below the fields of your particular interest, and send to CIBA Plastics Division Technical Service Headquarters.

C I B A

"FIRST IN EPOXIES"

the U. S. and Canada, CIBA produces basic resins only.

CIBA COMPANY INC., Plastics Division
Kimberton, Pennsylvania

MP-12

Please send me full information on CIBA Epoxy Resins for

- ☐ Tooling
- ☐ Electrical
- ☐ Structural Laminates
- ☐ Multi-purpose Adhesives
- ☐ General
- ☐ Surface Coatings
- ☐ Plastic Body Solders

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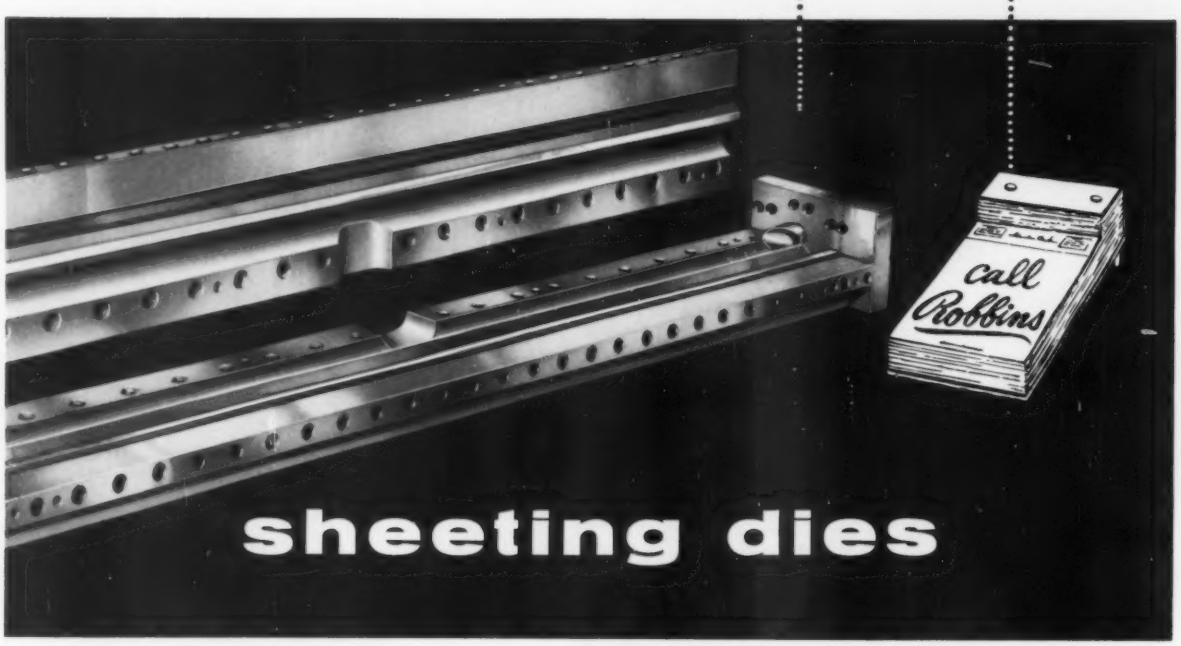
CITY _____ STATE _____

Got a die on the docket?



a specialty of
ROBBINS *die makers*

Need a sheeting die now . . . is one on a long range schedule? Call Robbins today. You have a real advantage in Robbins die making experience and you can use that advantage in the *early* planning of your particular job. Our die makers are experienced craftsmen in this specialized field and it is sound, common sense that they use this design talent to help you start right—end right, on time.

DIES OF EVERY KIND FOR THE PLASTICS EXTRUDER

Robbins
never say die . . . say Robbins die

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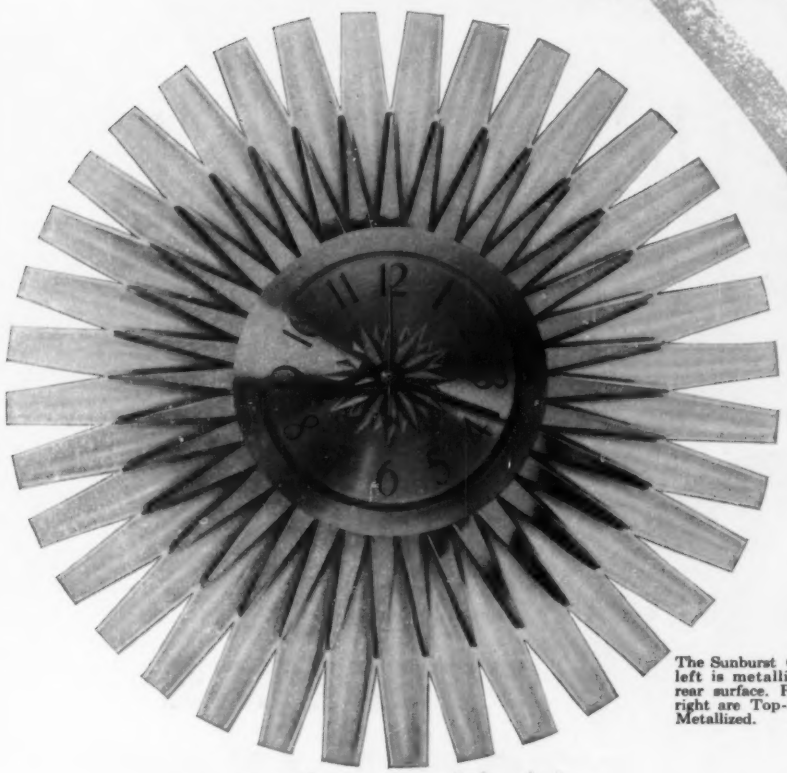
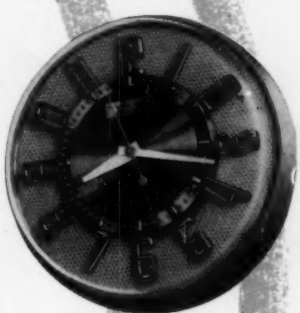
Subsidiary of Lynch Corporation, Anderson, Indiana, U.S.A.

Time CAN BE BEAUTIFUL

. . . . when marked by these sparkling General Electric-Telechron Dials and Cases





The Sunburst Case at left is metallized on rear surface. Parts at right are Top-Surface Metallized.

custom molded by ERIE *plastics*

The dial and the case make the clock, and the ultramodern General Electric-Telechron line stops traffic wherever it is shown. It furnishes an outstanding illustration of what plastics can do to add to sales appeal. It also furnishes an illustration of what ERIE can do to make your designer's dreams a reality.

The ERIE Top-Surface Metallizing used on these clock parts to produce a lasting, non-tarnishing metallic brilliance, is appropriate for many products. ERIE is also known for the outstanding beauty of its three dimensional moldings for nameplates, trademarks, and functional pieces that combine jewel-like richness with utility. Whatever your molding problem, it will pay you to consult ERIE Plastics Division of Erie Resistor Corporation.

ERIE *Plastics Division*

ERIE RESISTOR CORPORATION

MAIN OFFICES: ERIE, PA., U.S.A. FACTORIES: ERIE, PA. • HOLLY SPRINGS, MISS.

Out of this World

PEERLESS ROLL LEAF

for Plastics Marking

You too, will discover that the PEERLESS process of marking plastics is out-of-this-world. Practical, and yet inexpensive, is the PEERLESS method of trade-marking, identifying, and decorating parts and products made of plastics, paper, wood, fibre, leather, fabrics, etc. Engraved and embossed effects at high printing speeds . . . wide range of colors, including gold and silver. Stamping presses to meet every need . . . hand, electric motor, compressed air . . . semi to fully automatic feed and delivery. A PEERLESS Roll Leaf "label" does not wear or rub off, because it is engraved into the surface of the material, forming a permanent, integral part of the product. If you want proof of this "out-of-this-world" PEERLESS process of plastics marking, write or phone for samples or ideas.

Achievement toward Perfection

PEERLESS ROLL LEAF COMPANY, INC.

4511 - 4515 New York Ave., • Union City, N. J.

BRANCH OFFICES: BOSTON • CHICAGO • *Peerless Roll Leaf Division* • GANE BROS. & LANE, INC.
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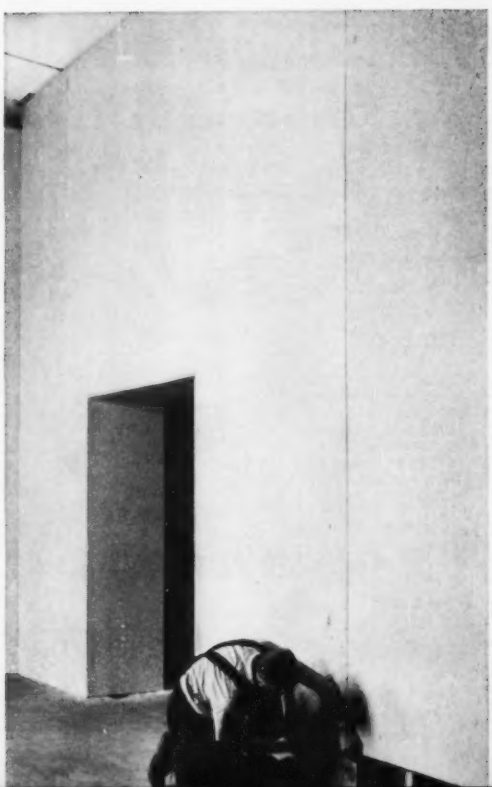
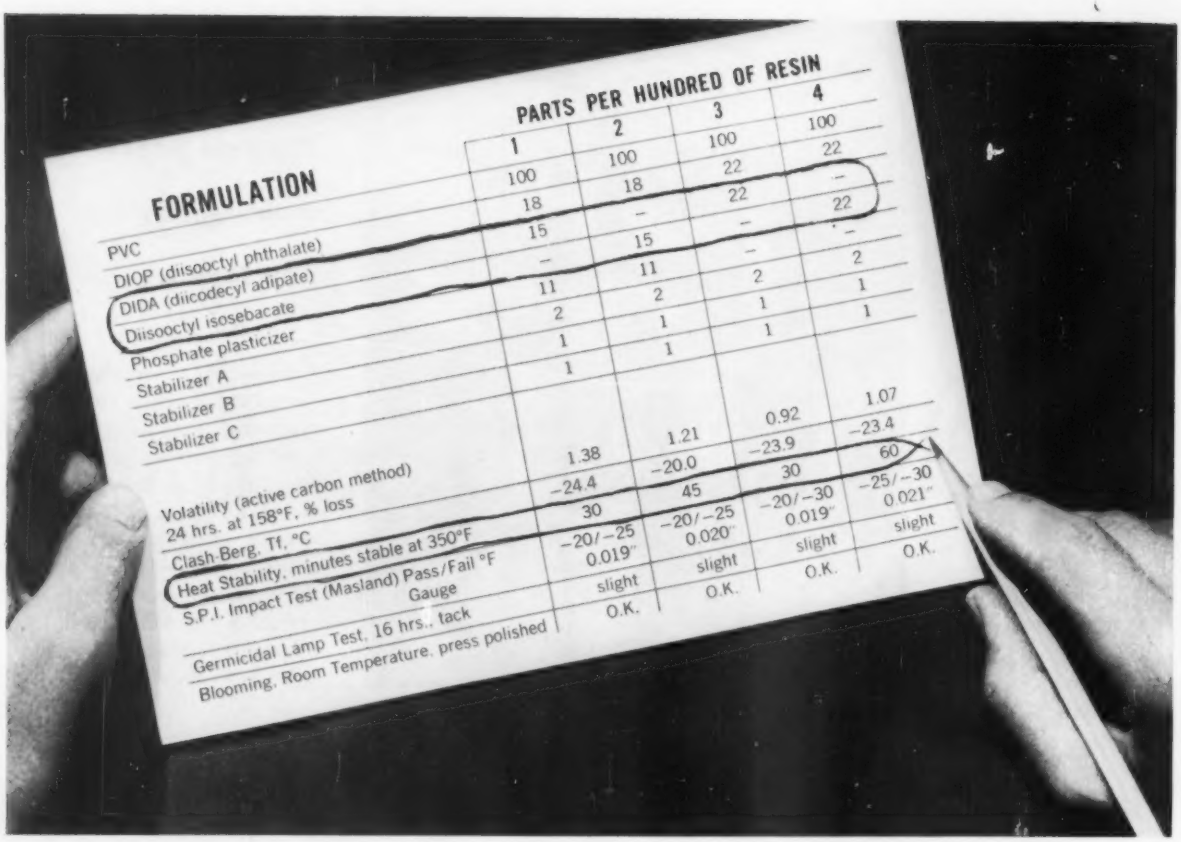
Particle board manufactured in any length

● Horizontal joints in wall linings and partitions can be avoided by using particle board manufactured to the exact length required. The Bartrev Press makes this possible without wastage and the continuous nature of the process ensures accurate control of production conditions resulting in consistently high quality board.

BARTREV



International Plastics Limited
3 Vere Street, London, W.1, England


FORMULATION
PARTS PER HUNDRED OF RESIN
1 2 3 4
PVC 100 100 100 100
DIOP (diisooctyl phthalate) 18 18 22 22
DIDA (diicodecyl adipate) 15 – – –
Diisooctyl isosebacate – 15 22 22
Phosphate plasticizer 11 11 – –
Stabilizer A 2 2 2 2
Stabilizer B 1 1 1 1
Stabilizer C 1 1 1 1
Volatility (active carbon method) 24 hrs. at 158°F, % loss 1.38 1.21 0.92 1.07
Clash-Berg, Tf, °C –24.4 –20.0 –23.9 –23.4
Heat Stability, minutes stable at 350°F 30 45 30 60
S.P.I. Impact Test (Masland) Pass/Fail °F –20/–25 –20/–25 –20/–30 –25/–30
Gauge 0.019" 0.020" 0.019" 0.021"
Germicidal Lamp Test, 16 hrs., tack slight slight slight slight
Blooming, Room Temperature, press polished O.K. O.K. O.K. O.K.

This test shows

HEAT STABILITY OF PLASTICIZED VINYLS IS IMPROVED BY ESTERS OF ISOSEBACIC® ACID

ISOSEBACIC® acid, a new synthetic 10-carbon dibasic acid, has many plus values that recommend it as an intermediate for vinyl plasticizers. You'll see one example in the above figures—results of a test made recently by a processor of vinyl plastic film.

Read down columns 1 and 2. *Heat stability improves 50%* (from 30 minutes to 45 minutes) when 15 parts of an ISOSEBACIC acid ester replace 15 parts of an adipic ester in this formulation.

Read down columns 3 and 4 and you see an even more striking result in a test where higher ester levels were used. ISOSEBACIC acid ester actually *improves heat stability 100%* (from 30 minutes to 60 minutes).

Among the plus properties of ISOSEBACIC acid esters as vinyl plasticizers are:

- Low color
- Low odor
- Low oil extraction
- Low soapy water extraction

And ISOSEBACIC acid has other uses in the plastics field. It can be used as an intermediate for polyamides, polyesters, polyurethanes and alkyd resins. If you make any one of them—or a vinyl plasticizer—it will pay you to evaluate U.S.I. ISOSEBACIC acid. Send today for data sheets and samples.

CHEMICAL PROPERTIES

ISOSEBACIC acid is a mixture of C-10 dibasic acids—2-ethyl suberic; 2,5-diethyl adipic; and sebacic. It undergoes typical reactions of dibasic acids. It yields acid and neutral esters, acid and neutral salts. Relatively stable, it is not oxidized by air at ordinary temperatures.

PHYSICAL PROPERTIES

Molecular weight	202.24
Combining weight	101.12
Density (80°C)	1.025 g/ml
	8.55 #/gal
Melt viscosity (80°C)	78.5 centipoises
Specific heat of vapor (226°C)	0.34 cal/g (est.)
Heat of vaporization (226°C)	107 cal/g
Specific heat of solid (24°C)	0.33 cal/g
Heat of Combustion	1296 K cal/mole
Flash point (closed cup)	430°F.
Ionization constant at 25°C	$K_1 = 3.5 \times 10^{-5}$
	$K_2 = 5.1 \times 10^{-6}$

U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corp.
99 Park Ave., New York 16, N. Y.
Branches in principal cities

SALES PROGRAMME

TROISDORF PLASTICS

Europe's oldest and largest manufacturer of plastics. 50 years of research and development have assured Troisdorf Plastics a leading position in the world's markets.
10 thousand skilled workers and employees are capable of solving your plastics problems.

RAW MATERIALS

SYNTHETIC RESINS: (Phenol-, Cresol-, Urea- and Melamine-Resins) Technical Resins and Bonding media for Moulding Materials, Laminated Products, Wood Fibre Boards, Grinding Wheels, Castings, Carbon Brushes, Friction Plates Brake Linings, Glass Fibres, etc. Adhesives and Bonding Resins

PRESSURE MOULDING MATERIALS:

Trolitan (Phenolic grades, all types)
Ultrapas (Melamine grades)
Pollopas (Urea grades)
Mipolam (Polyvinylchloride grades)

LONG PLAYING GRAMOPHONE RECORD MATERIAL (COPOLYMERS)

INJECTION MOULDING MATERIALS:

Trolit W (Plasticised Cellulose Acetate)
Mipolam (Polyvinylchloride with plasticiser)
Trolitul (Polystyrene and Copolymers)

RAW MATERIALS FOR THE LACQUER INDUSTRY

Collodion Cotton (Cellulose Nitrate): all grades and viscosities used in the manufacture of Lacquers, Adhesives, Artifical Leather, Celluloid made from grade A Cotton Linters or from selected grades of wood-cellulose, damped with butyl, ethyl or methyl alcohol.
Chips composing Cellulose Nitrate with Di-butyl Phthalate (colourless)

MIPOLAM

Mipolam: (PVC combined with selected plasticisers), Cable insulation and sleeving materials, Compounds for the extrusion of tubing and profiles, Extruded profiles for technical and other purposes, Pressed sheets for technical appliance, Embossed or polished sheets and foils for the Leather Goods Industry, Foils for decoration and other purposes
Trovidur: (Rigid PVC) Foils sheets, blocks, tubes, rods, drilled rods, welding rods.
Special Adhesives for the above materials
Trolen: (Polyethylene in various concentrations) Foils, sheets, special foils for packaging

DECORATIVE AND CONSTRUCTIONAL MATERIALS

Decorative Panels:
Ultrapas: Melamine resin-bonded sheets in light colours including white and pastel shades
Trolesit: Phenolic resin bonded sheets in dark colours only
Mipolam: (PVC combined with selected plasticisers) Floor and table covering, protective profiles for treads, handrails for banisters, etc.

CELLULOID

Celluloid: (Cellulose nitrate) sheets, rods, tubes
Cellon: („non-flam" cellulose acetate) sheets, rods, tubes, special qualities for lamp shades, watch glasses, gas masks, signal lamps, safety glass, etc.
Astralon: (vinyl copolymer) sheets, rods, tubes laminates (multi-coloured for labels, sign boards. etc.), special quality for use in cartography, cadastre, surveying lithographic printing and photography.
Astralon T: Vacuum quality for deep drawing purposes, e.g. refrigerator door panels and inner linings, motor-car plates, perambulator linings, for packaging, etc.
Trosifol: (polyvinyl butyral) foils for safety glass
Trolitul ST: (high-impact Polystyrene) in sheets for vacuum forming and deep drawing.

MACHINED ARTICLES

Bearings, cog-wheels and other machined parts made from laminated plastics. Specially designed apparatus and appliances made from chemically resistant plastics.
Tregamid: (Super-Polyamide) Rods, tubes, blocks, profiles.

SEMI-FINISHED-PRODUCTS

Laminated Products: (Phenol, Cresol, or Urea-Formaldehyde Resin Bonded)
Dytron: Fabric base, grades G (coarse cotton), F (fine cotton), Z (wood cellulose fabric)
Trolitax: Paper base, all standard types, also special grades
Ultrapas: Paper base, light colours including white
Metro: Laminates with metallic core
Lignofol: Veneer base, compregnated wood
Rods, Tubes, Profiles: Trolit B: } Cellulose derivates
Trolit P: }
Trolitul: Polystyrene
Sheets: Trolitul (Polystyrene)

Cast Synthetic Resin:
Trolon: in transparent, translucent, and opaque colours, Blocks, sheets, rods, tubes, profiles, castings
Photo-elastic material (VP 1527) (on base of unsaturated polyester resin)

VULCANIZED FIBRE

(Hydrated Cellulose). Dynos: Vulcanized Fibre in rolls .004" up to 1/2", Leatheroid .004" and over, Fishpaper, Panels, non-glued, up to 1 9/16" Round Bars, non-glued, .080" up to 1 9/16 Tubes. For the electric, metal, automobile and textile industries, construction of machines, for the manufacture of trunks, for punching methods. Shaped Parts:- Reel discs, washers, high pressure sleeves, piston rings, plug covers, ball joints etc. Containers:- Spinning cans, transporting waggons and boxes for the textile industry; bags and boxes for transport and storage.

MOULDED ARTICLES

Mouldings from thermosetting and thermoplastic materials for technical applications, especially large and intricate objects made by compression or transfer moulding.

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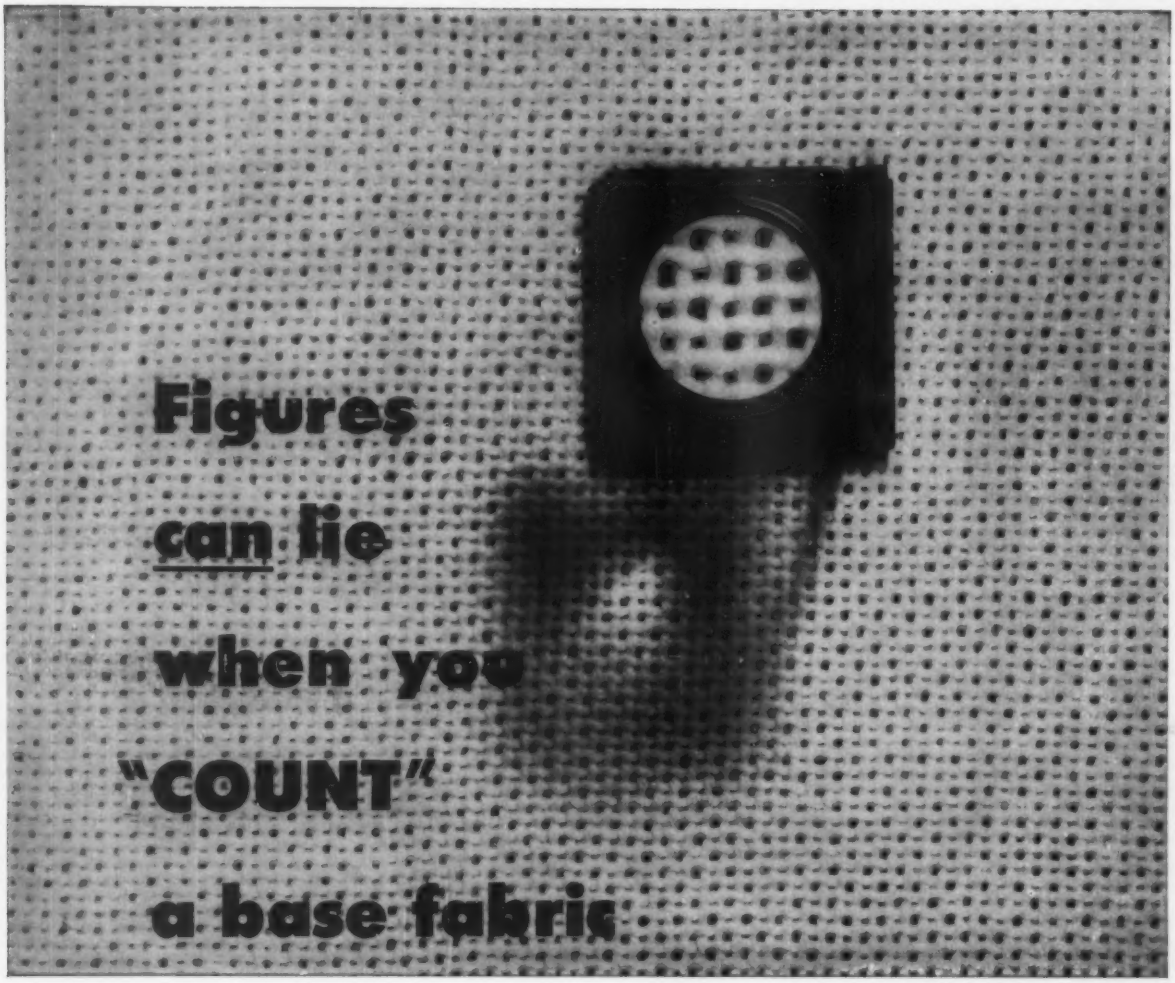

Yarns-per-inch "count" of grey fabric can be completely misleading because of changes produced by finishing and subsequent processing!

"Count" tells how open or tight a woven fabric is. The number of yarns per inch of cloth affects absorbency, adhesion, permeability, strength, bulk, flexibility and other characteristics related to fabric-reinforced plastic or rubber products. But if count is taken in the "grey," dimensional changes caused by pre-shrinking, heat-setting, calendering, napping, singeing, pre-dipping or other processes will not have been considered—and end-product performance may suffer.

Of course, thread count is but one of many factors affecting fabric performance. When your base fabric is one of the wide variety provided by Wellington Sears for coating, laminating, combining and rubberizing, you know that everything has been considered in the light of *your specific need.* And moreover you know that a century of experience is working for you, to anticipate and help solve your basic fabric problems. For free booklet, "Fabrics Plus," write Dept. K-12, Wellington Sears Co., 65 Worth St., New York 13, N. Y.

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Whatever your industry or plastic part requirements, American's your answer. One of the nation's oldest and largest manufacturers of plastics, American offers facilities for injection, extrusion, double-shot injection molding, low pressure and vacuum assisted molding, and reinforced fibreglass. American's ultra-modern equipment can mold most types of plastics, including cellulose acetate and butyrate, polystyrene, acrylics, reinforced fibreglass and copolymers. American's giant plant can handle every stage of manufacture from design to mass production. Regardless of whether your plastic problem is clear-cut or complex . . . regardless whether your needs are small or large, call upon American for the economical, quality answer. Write direct for further information today. Address Dept. A.

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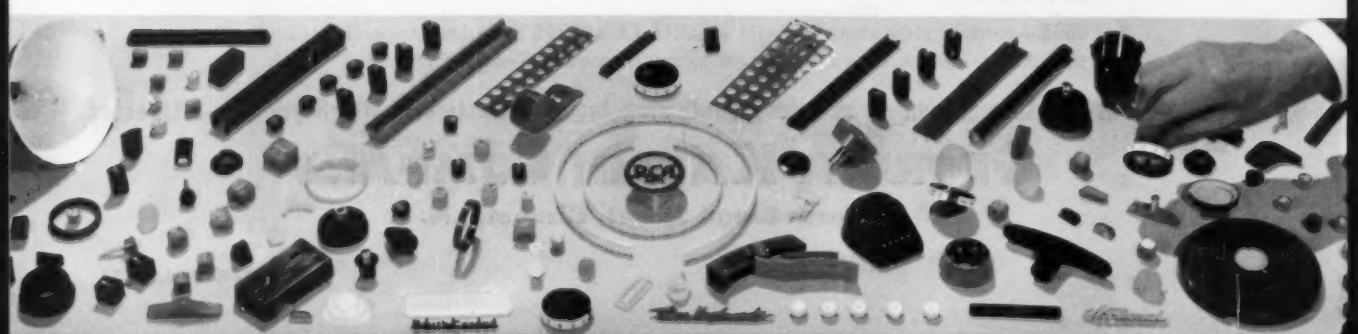
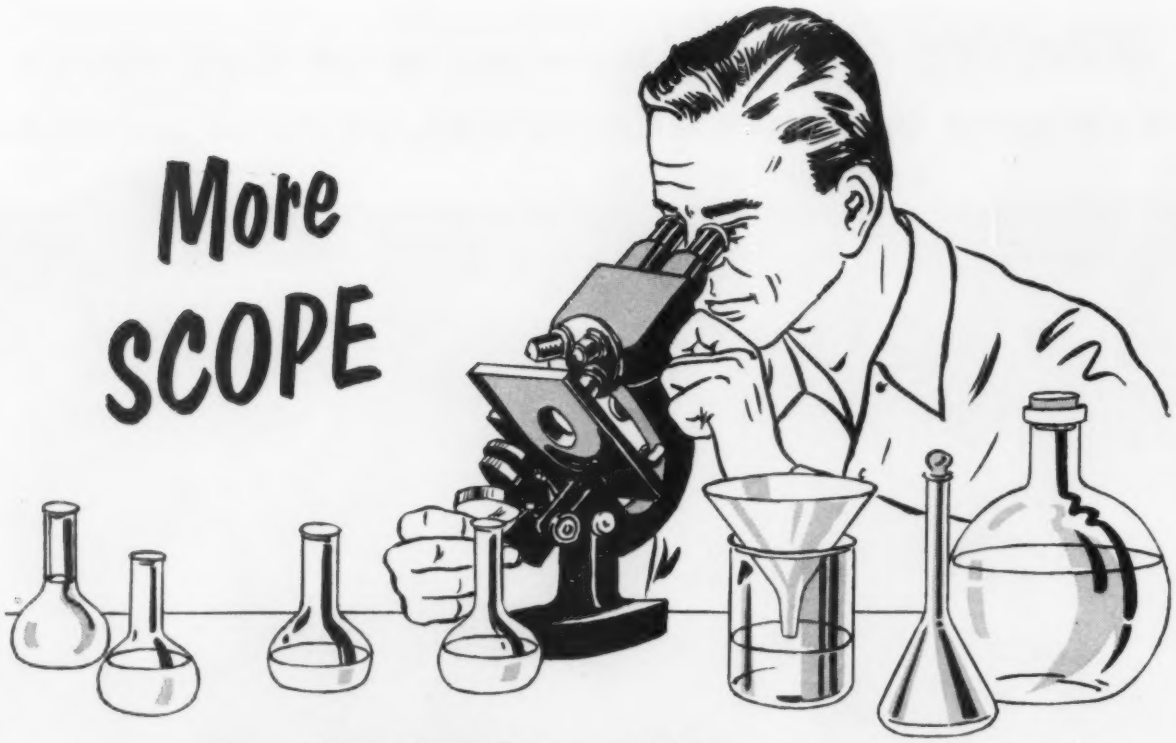




for Plastics Formulators

with GK HYDRITE KAOLINITE FILLERS

HYDRITE KAOLINITE CLAYS offer the Plastics Formulator a mineral filler of unequalled versatility. They give outstanding results in the following reinforced plastics:

POLYESTER RESINS, CHLORINATED POLYESTER RESINS, EPOXY RESINS, DIALLYL PHTHALATE RESINS AND PHENOLIC RESINS.

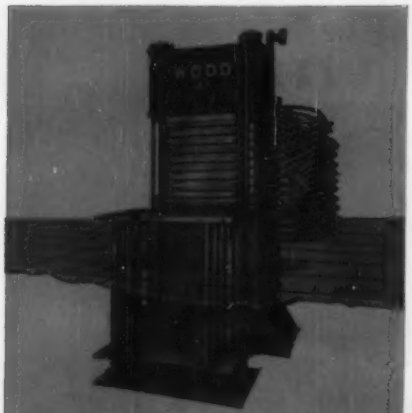
Among the properties of reinforced plastics favorably affected by **HYDRITE KAOLINITE FILLERS** are:

1. **WATER ABSORPTION**—minimized due to kaolinite's chemical inertness and insolubility.
2. **HEAT ABSORPTION**—reduces exotherm and shrinkage.
3. **PHYSICAL, ELECTRICAL, CHEMICAL PROPERTIES**—all are improved substantially by **HYDRITE KAOLINITES.**
4. **FLOW AND HANDLING CHARACTERISTICS**—improved by **HYDRITE KAOLINITES** without affecting molding or fabrication processes.
5. **SURFACE**—the structure of the kaolinite particles improves the smoothness and gloss of molded parts.
6. **COSTS**—considerably lower because **HYDRITE KAOLINITES** have lower specific gravity than other mineral fillers, thus displacing maximum amount of expensive resin.

Send for further information or samples, mentioning type of plastics in which you are interested.

GEORGIA KAOLIN COMPANY

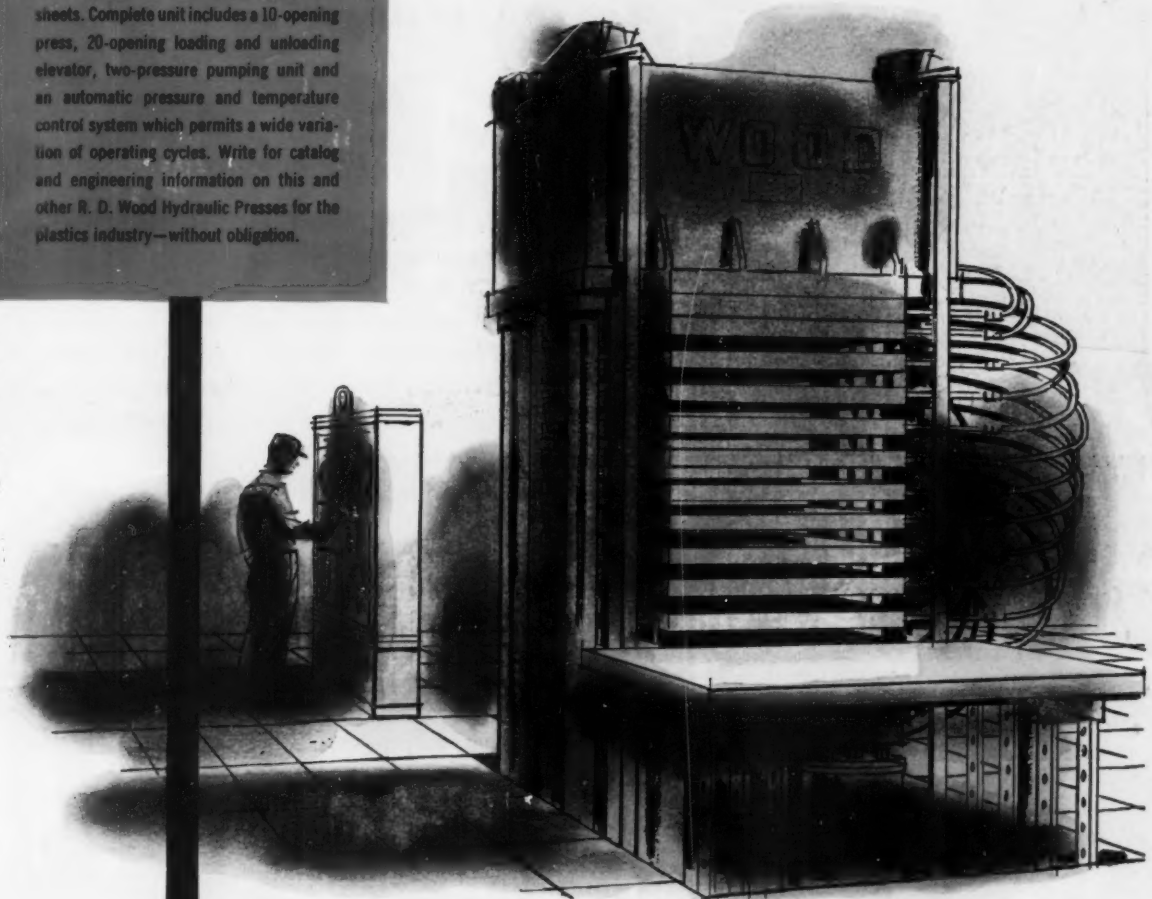
433 North Broad Street, Elizabeth, N. J.



880-ton Multiple Opening Platen Press (HydroLectric). This precision press is designed for polishing and laminating plastic sheets. Complete unit includes a 10-opening press, 20-opening loading and unloading elevator, two-pressure pumping unit and an automatic pressure and temperature control system which permits a wide variation of operating cycles. Write for catalog and engineering information on this and other R. D. Wood Hydraulic Presses for the plastics industry—without obligation.

You'll like what it does to production

It's just plain common sense—when your down-time decreases your production is bound to increase. Down-time can't be eliminated, but R. D. Wood Presses hold it to a minimum. The sound design, choice materials and careful craftsmanship that go into a Wood Press produce a superior product—a dependable, smooth-working press that can't help but increase production records. Write for our catalog and engineering information—no obligation.



R. D. WOOD COMPANY

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WHY CYCOLAC®

HIGH IMPACT THERMOPLASTIC RESIN

in the Elgeet AUTO-EX 8mm Lens?

. . . the answer is simple . . .

Only CYCOLAC, with its outstanding properties, could satisfy the exacting requirements of the Elgeet Optical Co. of Rochester, New York. CYCOLAC's high impact strength and resistance to heat and cold was most desirable. In addition, CYCOLAC has excellent moldability for intricate designing, a tough and glancing surface, excellent shock absorbing properties, dimensional stability, plus a wide range of color possibilities.

molders • extruders • calenderers

Compare these added CYCOLAC Benefits!

In addition to CYCOLAC's unique balance of properties, which makes it ideal for hundreds of end-use products, you get these added benefits!

- No breakage in processing.
- No breakage in assembling and finishing operations.
- Better adherence to dimensions and tolerances.
- Readily lacquered, enameled or printed. Decals apply easily.
- Greater uniformity of processing.
- Lower shipping costs.
- Light weight means more parts per pound.

CYCOLAC can also work wonders for you. This family of single uniform resins is permanently thermoplastic, permitting fast molding, calendering and extruding. It is economical to form press-polished sheets by vacuum, air-pressure, or mechanical methods over inexpensive molds of wood, plaster, aluminum, etc.

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SYNTHETIC RESINS

Division of BORG WARNER • Gary, Indiana

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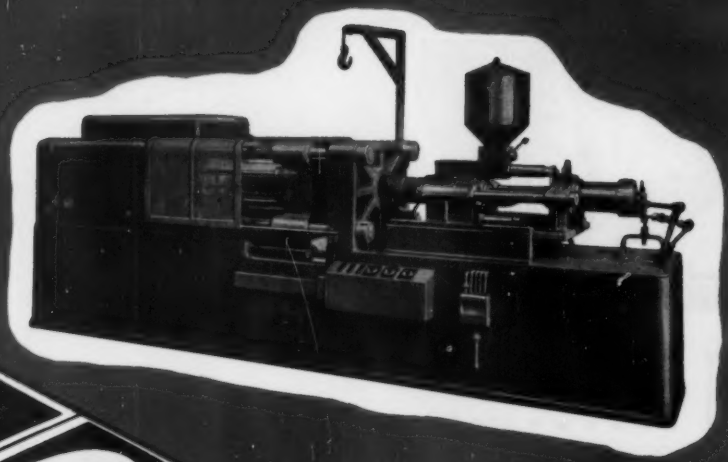

Injection Moulding Machine
capacity: 1, 2, 4, 6, 10 oz.

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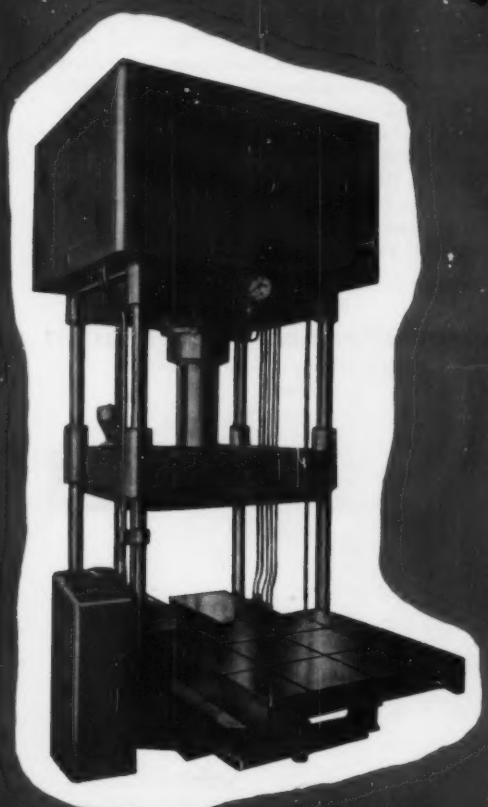
Low Pressure Press for
Reinforced Plastics
capacity: 35, 62, 100, 200 tons

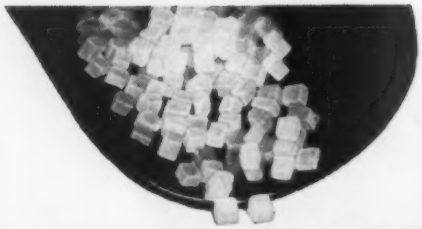


Compression Moulding Press
for Thermosetting Materials
capacity: 35, 62, 100, 185, 270, 600 tons

Machines for

Plastic

Materials



WHERE POLYETHYLENE IS USED...

A-C® Polyethylene ..... delivers • **QUALITY!** • **SAVINGS!** • **SPEED!**

...for INJECTION MOLDING

Molders who use A-C Polyethylene in their operation gain distinct competitive advantages. Controlled gloss, better color dispersion, and the ability to run larger, more intricate parts are the definite product advantages. Faster cycles, positive mold release, lower operating temperatures and less overall machine maintainance, are the profit-making features contributed by the controlled flow possible with A-C Polyethylene. By simply changing the percentages of A-C Polyethylene, you can greatly reduce the variety of polyethylene grades required in inventory and still have control of resin flow characteristics to meet all kinds of molding problems.

...for FILMS, PLAIN AND COLORED

In the extrusion of Polyethylene films, adding A-C Polyethylene gives faster rates, lower extrusion temperatures, lessens machine stress, and makes gauge control easier.

For colored film, A-C Polyethylene is invaluable for even, streakless pigment dispersion. Colored films using A-C Polyethylene dispersed color pigments are strikingly brilliant and uniform.

...for SLUSH MOLDING

A-C Polyethylene offers an entirely new material for slush molding. With this new polymer you can use less expensive molds, get faithful mold reproduction with fine detail and the finished part has a warm, "life-like" feel. Finishes from dull to high gloss are possible.

...for COATINGS

Coatings containing A-C Polyethylene give a hard, scuff-resistant, glossy surface. Excellent low temperature flexibility and the elimination of blocking problems are added attractions to the converter.

Bread and frozen food wraps are glossy and scuff-resistant.

Shipping cartons are grease resistant and need no liner to protect contents from fibre scratchings.

Butter and frozen food cartons, and bakery cartons are grease resistant and feed as single units to automatic packaging machinery.

POLYETHYLENE FOR POLYETHYLENE!!

A-C Polyethylene is a low molecular weight polymer of ethylene with a high melting point but a low melt viscosity. You can add A-C Polyethylene to other polyethylene resins with complete confidence in their compatibility. The improvements in product quality, the operational savings, and the production advantages derived from varying percentages of A-C Polyethylene, give you a flexibility in raw material which is unique in plastics operation. No special equipment is required to take advantage of A-C Polyethylene.

Two Forms — Range of Grades

A-C Polyethylene is available in two forms to meet a variety of production methods. For ease of handling the uniform cubes, as illustrated here, meet most requirements. A finely powdered form, called "atomized," is especially suited for certain more difficult blending operations. You can obtain either a hot melt polyethylene or water emulsifiable grade of this unique material depending upon the specific needs of your operation.

Write today for complete information. We will be glad to demonstrate the proven advantages of using A-C Polyethylene.

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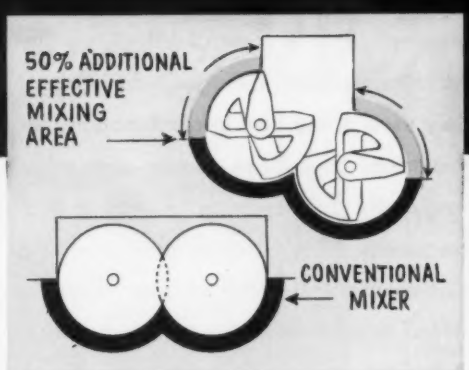
Allied Chemical & Dye Corporation
Room 522-Y
40 Rector Street, New York 6, N. Y.

Allied Chemical

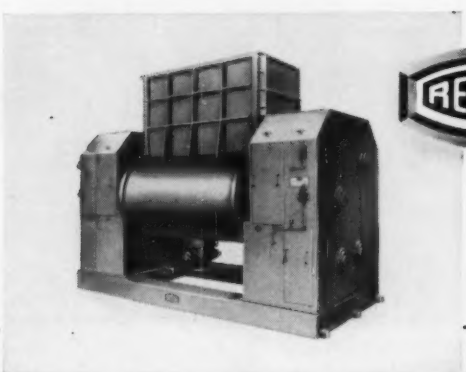
take this unique design... PRESTO! a much faster mix!



with Readco's unique split-level bowl: complete dispersion, shorter cycle, lower cost

The special design of this Readco mixing bowl provides a 50% greater effective mixing area. Overlapping sigma arms operate at minimum clearance from the shell, prevent build-up of materials, speed dispersion. The design also permits maximum heat transfer from the jacket.

You'll get complete dispersion, consistent mixing, in substantially shorter cycles. Working capacities range from 150 to 900 gallons. Write for complete information.



Whatever the mixing job: a READCO mixer!

READ STANDARD

York, Pennsylvania

A Division of
Capitol Products Corporation

See this mixer featured in our exhibit of processing equipment at the New York Chemical Exposition, December 2-6, Booth 162

In these five Standard Units are all the necessary components to control effectively the degradation mechanisms that take place in polyvinyl chloride resins on aging, during heat processing or on exposure to sunlight. They are widely used alone and in combinations for specific effects in clear and opaque stocks. Their advantages have been proven over other tested materials, such as those based on tin (which frequently decolorizes effects of degradation without correcting them) or on lead (which frequently contributes to oxidation and breakdown on aging). We also supply combinations of components selected from these five Standard Units, to correct special conditions encountered in each Vinyl Processing Industry.

Write for information about stabilizers designed for versatile and inexpensive use in formulations employed in your particular vinyl processing industry.

Is it for—

Quality Vinyl Flooring?
Non-Plating Calendered Stocks?
Maximum Clear Sheets?
Non-Sulfur Staining Films?
Low Cost Clear & Opaque Hose?
Top Physical Properties in Rigids?
Air-Releasing Plastisols?
Controlled Slush Molding?

This Stabilizer System is for

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Cd 2-V-4
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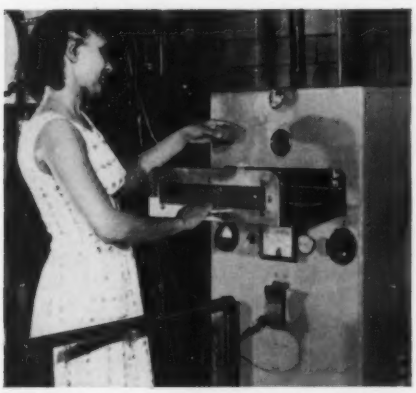
The HARSHAW CHEMICAL Co.

1945 E. 97th STREET • CLEVELAND 6, OHIO

J. M. Callihan, Sales Manager, The General Industries Company, Plastics Division, Elyria, Ohio, examines one of their plastic products.

"Excellent service!"



A "3R" Preheater . . . one of 53 THERMEX Preheaters at General Industries.

says General Industries... user of 53 THERMEX Preheaters

The performance record of THERMEX* Dielectric Preheaters at General Industries, Elyria, Ohio, speaks for itself. This progressive molder installed its first THERMEX Preheater 13 years ago, and has increased their number to 53 . . . ranging in size from ¾ to 7½ KW. Their satisfaction stems from a remarkable record of dependable, uniform preheating of preforms, and low maintenance.

A Girdler engineer will gladly study your molding operations to make recommendations for dielectric heating. Call our nearest office.

*THERMEX—Trade-Mark Reg. U. S. Pat. Off.

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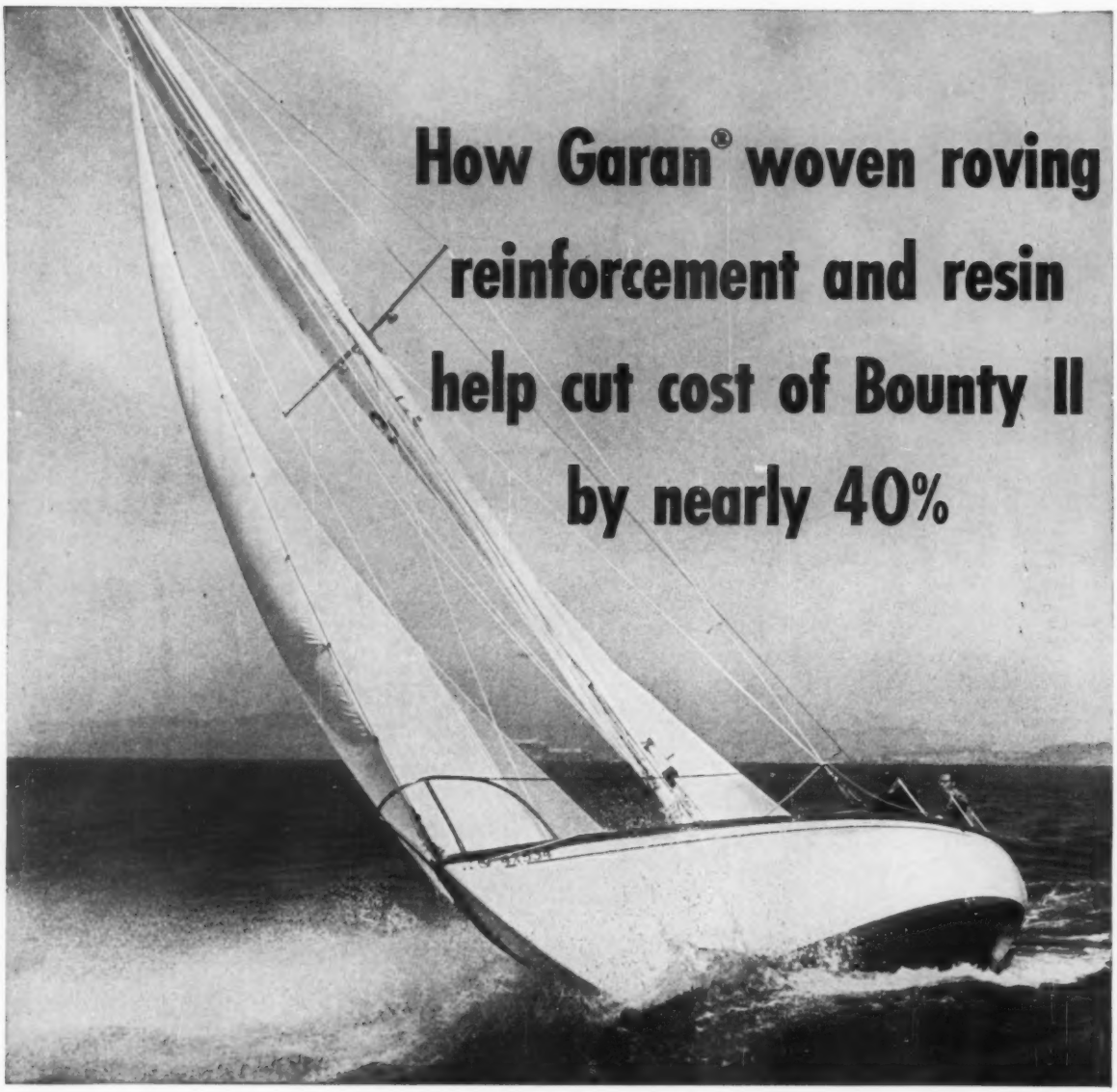

How Garan® woven roving reinforcement and resin help cut cost of Bounty II by nearly 40%

Molded hull, deck and mast of 40′-10″ Bounty II are made with Garan woven roving. Builder: Coleman Boat & Plastics Co., Sausalito, Calif.

Garan woven roving reinforcement helps make it possible to mold a 40-ft. Bounty II per week—at nearly 40% less than the cost of comparable wooden boats. Here's why:

Garan woven roving cuts production time and labor costs because it wets out 3 to 5 times faster. It conforms well to the mold . . . saves extra cutting and fitting. Because its greater bulk makes build-up 2 to 3 times faster, it costs less to use. And finished moldings are color-true because Garan woven roving adds no color of its own to pigmented resins.

Garan woven roving is a coarse, fabric-like reinforcement made from bundles of parallel glass fibers. The exclusive Garan sizing protects fibers during weaving, and improves glass-to-resin bond. This gives Garan woven roving special strength . . . makes possible stronger, more durable laminates.

These are the reasons why Garan woven roving is preferred by manufacturers of reinforced-plastic products such as boats, chemical piping, tanks, tooling fixtures, swimming pools and radomes. Find out today how *you* can profit from the time-saving, moneysaving properties of Garan woven roving. For sources of supply, write: *L·O·F Glass Fibers Company, Dept. 15-127, 1810 Madison Ave., Toledo 1, Ohio.*

L·O·F GLASS FIBERS

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'Perspex' makes your name stand out

Although installed 8 years ago, a photograph taken this year of a large 'Perspex' sign at the works of Smethwick Drop Forgings Ltd., Kidderminster, shows it to be still in excellent condition.

'PERSPEX' acrylic sheet is ideally suited to display signs in any part of the world. It retains indefinitely its handsome appearance under all normal weather conditions. 'Perspex' has a high impact strength; it is also light, tough, easy to form and handle.

Modern designers are making increasing use of this durable, highly versatile material. 'Perspex' acrylic sheet is available in a wide range of transparent, translucent or opaque colours. It is a good electrical insulator and, in its transparent form, it has a high light transmission and is the best possible material for illuminated displays. 'Perspex' signs are making new customers all day and far into the night — everywhere.

'PERSPEX'

'Perspex' is the registered trade mark for the acrylic sheet manufactured by I.C.I.

Imperial Chemical Industries Limited, Plastics Division: Export Dept., Black Fan Road, Welwyn Garden City, Herts.

U.S.A. enquiries to: J. B. Henriques Inc., 521 Fifth Avenue, New York 17, N.Y.

Canadian enquiries to: Canadian Industries Ltd., Plastics Dept., Box 10, Montreal, P.Q.

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Your plastic products will really go places when they're pigmented with TITANOX titanium dioxide white pigments. That's because nothing can surpass titanium dioxide for whitening, brightening or opacifying any type of plastic . . . vinyls, polystyrenes, cellulosics.

You will get the maximum benefits from titanium dioxide when you use TITANOX-RA. If you have a plastic pigmentation problem, consult our Technical Service Department. Titanium Pigment Corporation, 111 Broadway, New York 6, N. Y. Offices in principal cities.

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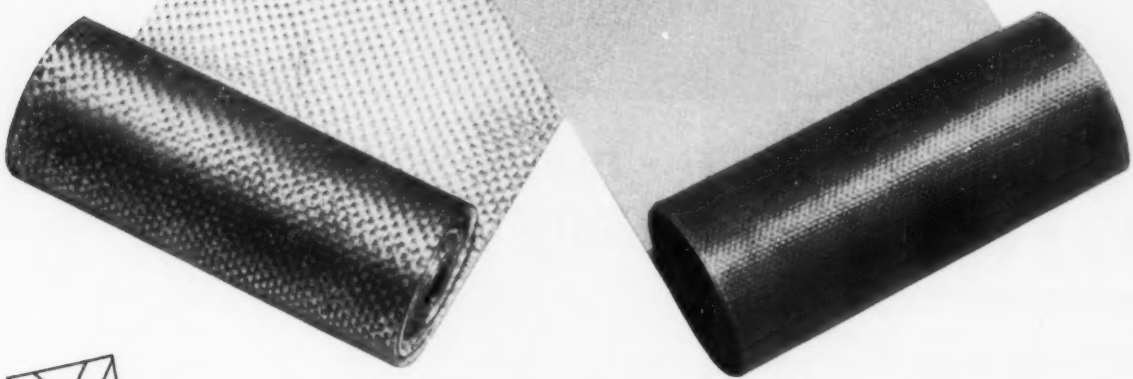
*TITANOX is a registered trade mark for the full line of titanium pigments offered by Titanium Pigment Corporation. 5213

send for technical data on

IMPREGNATED GLASS FABRICS FOR HIGH TEMPERATURE APPLICATIONS 60° F TO 10,000° F

Trevarno Silicone (F-130), Epoxy (F-160) and Phenolic (F-120) materials have been tested and proved for high-temperature, high-strength missile and aircraft applications. They give optimum heat resistance and strength performance in addition to exceptional electrical and mechanical properties. Chopped high temperature material is available for molded parts for performance at 4,000°F.

In addition to high-temperature, high-strength products, Trevarno glass fabrics are available impregnated with Polyester (F-58), Phenolic (F-92) and Epoxy (F-150) resin systems for general, all-purpose molding. Custom materials can also be developed with fabric weight, weave, thickness and impregnation to suit your individual specifications.



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GLASS FABRICS

COAST MANUFACTURING AND SUPPLY COMPANY
P. O. Box 71, Livermore, California

Please send me data on materials for the temperature ranges or resin systems I have checked below:

- ☐ 60°F to 160°F
- ☐ 160°F to 750°F
- ☐ 800°F to 1500°F
- ☐ 1500°F to 10,000°F
- ☐ Phenolic
- ☐ Epoxy
- ☐ Silicone
- ☐ Polyester
- ☐ Fabric
- ☐ Chopped Fabric

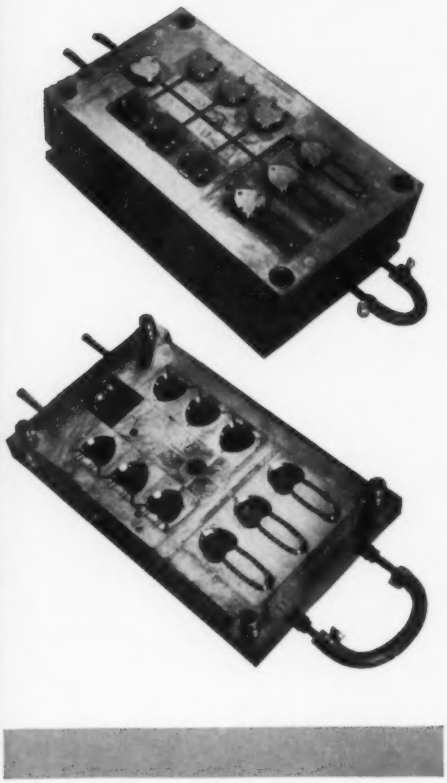
Name_____

Company_____

Address_____

City_____ State_____

4065



Parts for Plastic Rattles Made economically with Lustre-Die

One never knows where Lustre-Die tool steel is going to turn up next. At Shreve Molded Products, Youngstown, Ohio, it is used in an injection molding die to produce heart-shaped parts for baby rattles, made of acetate and styrene plastics. The mold was produced by Tri-Penn Tool Co., Erie, Pa., from steel supplied by Leed Steel Co., Buffalo, N. Y.

Engineers at Shreve like Lustre-Die for its wear-resistance and all-around economy, plus its ability to take a high polish. Working at 2000 lb injection pressure in a 12-oz molding machine, the die molds finished pieces at the rate of one per second.

Lustre-Die is an ideal steel for molding plastic parts because it takes an unbelievably bright, mirror-like polish. What's more, its basic analysis is just right for working with plastics. But we even go a step beyond that—we enhance Lustre-Die by means of alloy fortification, thus improving its already excellent properties. Then we oil-quench and temper this grade, so that it is ready for machining and polishing.

Lustre-Die is made in an electric furnace, and is carefully inspected to insure absolute cleanliness. It has a minimum of inclusion-causing additions. Besides, modern inspection methods hold injurious porosity to the minimum.

Lustre-Die is good, sound steel for your next plastic-molding job. Your Bethlehem tool steel distributor has it in stock.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

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3 "Dutch Boy" Lectro Stabilizers ready now for next year's wires

These new Lectro series stabilizers are "Dutch Boy" quality ... made to the same high standards as such proven performers as "Dutch Boy" Tribase or Dutch Boy Dythal® Stabilizers.

Try the Lectro series in your new formulations. We'll be glad to help ... with technical data and formulating suggestions. Just write.

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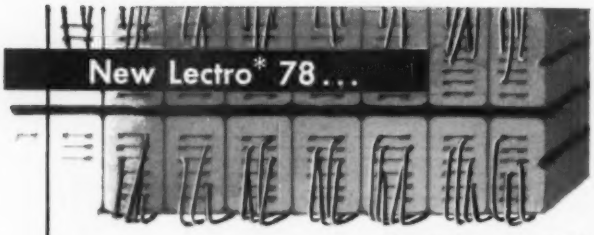
New Lectro* 78...



105° and experimental higher rated wire

Stabilizer for severe heat service conditions

Lectro **78** is a new "Dutch Boy" lead stabilizer developed particularly for high temperature vinyl insulations. Tests indicate (1) it stabilizes against extreme processing temperatures without gassing; (2) it imparts exceptional heat service life.

Lectro **78** sets new highs for volume resistivity over a range of temperatures in tests made according to Underwriters' Laboratory procedures on T, TW, 90°C and 105°C coated wire. In the same series it shows outstanding moisture resistance, as well.

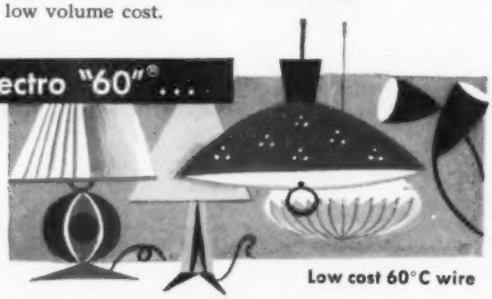
New Lectro* 77...

Special purpose 60°-80°C wire

A most versatile insulation stabilizer

Lectro **77** ... another new "Dutch Boy" lead stabilizer ... promises unique versatility. For one thing it is an unusually good stabilizer with phthalate and many special purpose plasticizers. Secondly it provides excellent resistivity and outstanding moisture resistance at unusually low volume cost.

Lectro "60"®...



Low cost 60°C wire

"Dutch Boy" Stabilizer. For lowest volume cost

In 60°C wire, Lectro **60** lead stabilizer provides much the same benefits as Lectro **77** ... combined with rock bottom volume cost.

Baby Playthings

Toddler Toys

Housewares

Modern House Fittings

Outdoor Living Aids

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Symbols of your potential through Tupper Corporation

Premiums

● Whatever your custom needs in plastics manufacturing, call on Tupper's wide experience and modern manufacturing facilities. Our large, up-to-date plants, equipped with the best production machinery, are available for materials, injection molding, extruding, vacuum forming, blow molding—and other advanced processes.

The Tupper Engineering Department has developed the greatest number of patents in the industry for polyethylene seals, closures, and dispensers—and other items in other plastics. This know-how can be tapped by you to place your plastic products in a position of leadership.

Tupper seals and other Tupper products are protected against unauthorized manufacture by about 150 U. S. and foreign patents and patents applied for, plus numerous trademarks and copyrights.

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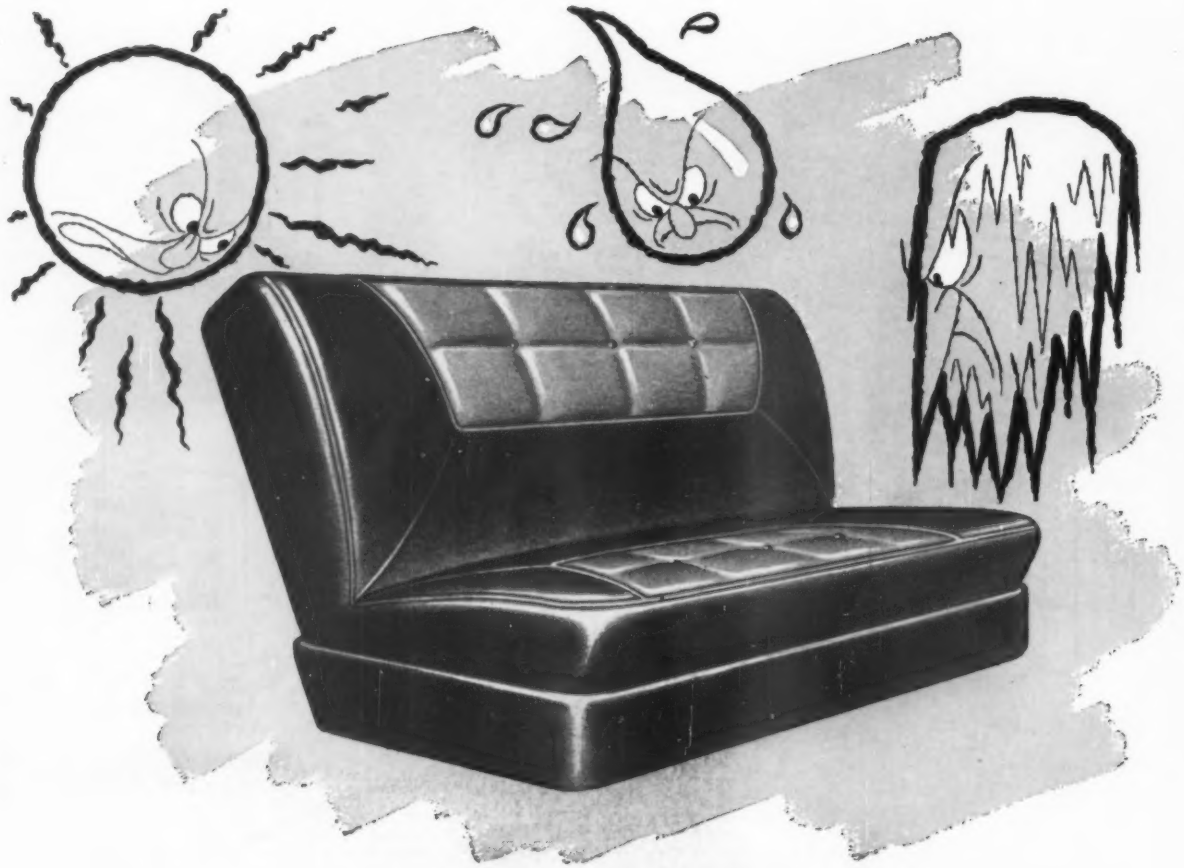

PLASTOLEIN® 9058 DOZ meets the tough requirements of Automotive Upholstery...

Most manufacturers of automotive vinyl fabrics use Plastolein 9058 to give them low temperature performance required by the conditions of use in automobiles, trucks, buses, trains, and other transportation vehicles. Not only does Plastolein 9058 impart low temperature flexibility but it provides good overall extraction, volatility and stability properties.

If your product must meet tough conditions of use that involve low temp. flex., whether it be automotive fabrics, outdoor upholstery, outerwear, rainwear or a host of others, Plastolein 9058 DOZ or 9057 DIOZ assures you the biggest available safety factor against stiffening and failure.

For the complete details on Plastolein 9058 DOZ and all other Emery plasticizers, mail coupon below.

Emery **Organic Chemical Sales Department**

Emery Industries, Inc., Carew Tower, Cincinnati 2, Ohio

EMERY INDUSTRIES, INC.
DEPT. F12, CAREW TOWER
CINCINNATI 2, OHIO

Please mail copy of 32-page EMERYFACTS titled "Plastolein Plasticizers"

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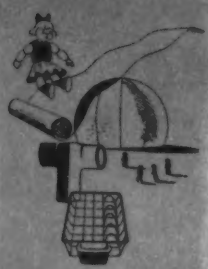
MODERN PLASTICS
Volume 35
December
1957
Number 4

Don't miss...

The most versatile materials known to man are the vinyl plastisols. Slush molded or rotationally cast they become dolls and other toys. By continuous casting they become film, or coatings for metal and fabric. By dipping they give protection to other materials. The new rigid plastisols are opening up new fields of application. With all this, and with formulations to achieve predetermined properties, the plastisols are quite inexpensive for the purposes they serve. There is hardly an end product made that cannot be improved by their use. See "Keep pace with the plastisols," p. 103.



New sheet extrusion plant, specially engineered and equipped for high-speed, precise-quality product, involves new control principles. Here it is pictured and described by an engineer who helped to create it. This is the kind of plant that will be copied. See "Automated sheet extrusion," p. 122.

Better moldings and better output result from proper mold temperature control. Rejects are lowered, post-molding shrink is minimized. Here are four plans of circulating-liquid control described and compared. See "Mold temperature control—why and how," p. 144.

Latest developments in reinforced plastics materials, equipment, and techniques will be presented at the 13th conference of the Reinforced Plastics Div. of the S.P.I., February 4, 5, and 6, 1958, at the Edgewater Beach Hotel, Chicago, Ill. The program committee, by prodigious effort, has enabled us to present the program a full month ahead of normal schedule. Those who are interested (and few are not) will find this program beginning on p. 180.

A new thermoplastic, linear, strong, and tough even at high temperatures promises new opportunities in product design. This resin won't be commercially available for a couple of years—but many end products take that long in design and engineer stages. See "Polyacetal resin—a new engineering material," p. 153.

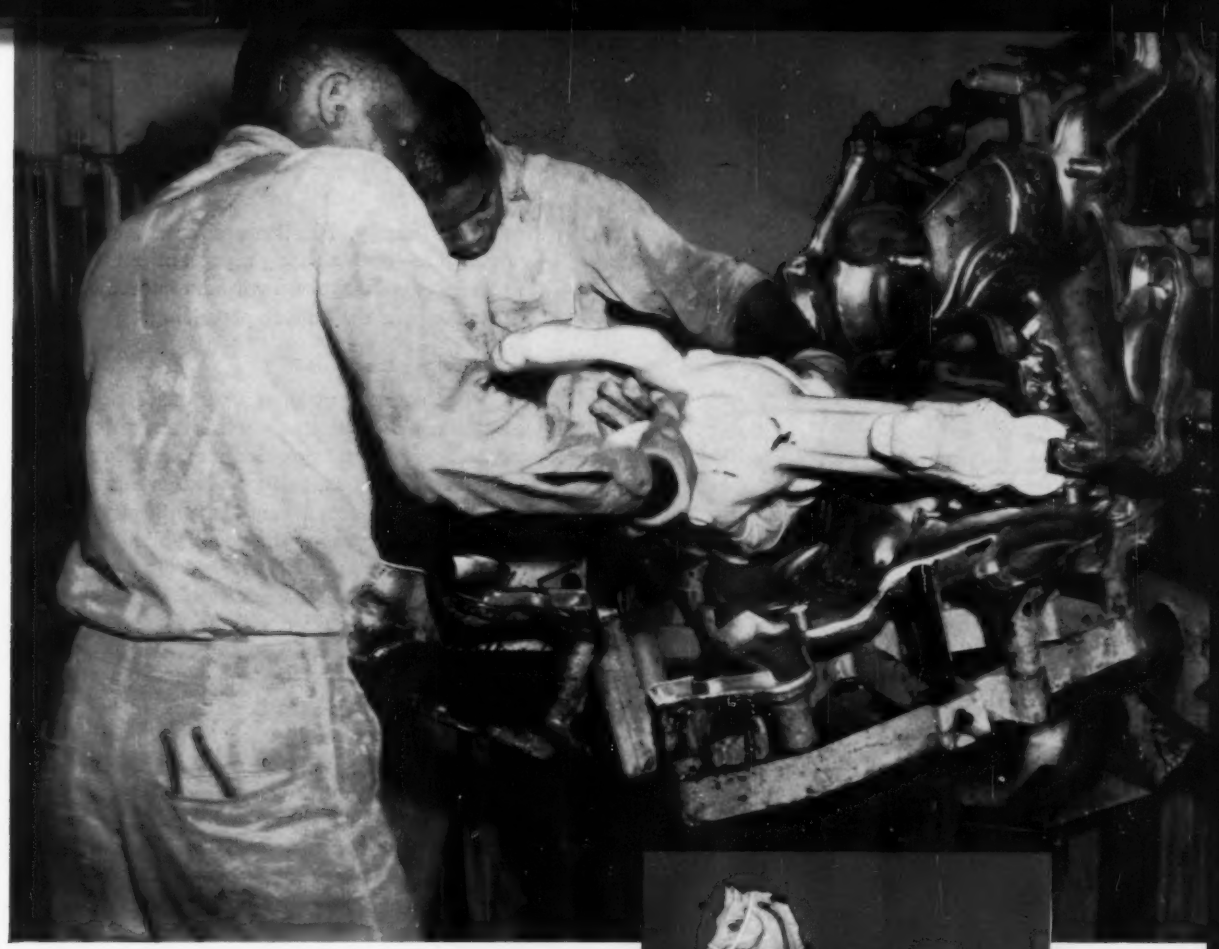
Having trouble with film heat sealing? The results of a study show how operating factors and resin characteristics influence seal strength and point the way to optimum sealing techniques. See "Factors affecting the heat-sealing of polyethylene film," p. 133.

Revolution in optics through the use of specially formulated plastics is rapidly changing the lens market. First developed for safety goggles, plastics lenses are now custom-designed for precision, for improved light transmission, and for ultra-violet light control. See "Plastics lenses," p. 118.

What can you do with low-molecular-weight polyethylene? Economy, easier molding, and improved finish are some of the claims made for this material when it is added to regular polyethylene. See "Why low-molecular-weight polyethylene?" p. 109.

Need help with inserts? New technique allows for high-speed, automatic loading of inserts for molded plastics parts. It is called "blow-loading" and combines pneumatic and mechanical action to load small inserts into a collector plate. For automatic molding it offers advantages. See "Automatic blow-loading of inserts," p. 137.

Watch for... our January review of materials expansion, applications progress, engineering and technical advances in 1957 . . . some surprises are in store for you in this issue . . . a complete review of the market for and methods of manufacturing plastics boats in the February issue . . . more articles in the series on the economics of extrusion . . . more descriptions of new automated plastics processing plants . . . a series of articles on the various kinds of plastics pipes . . . new developments in thermoforming . . . and more about new markets!



Figs. 1 and 2: Rotational molding techniques should do much to speed up production of vinyl plastisol products. In the six-mold arrangement shown above, a 32-in.-long one-piece body for a hobby horse (right) can be turned out approximately every 3 minutes. Almost 6 lb. of plastisol go into each hobby horse body. (Photos, Storkline Furniture Corp.)

KEEP PACE WITH THE

Plastisols

Today's vinyl plastisols
are so versatile
that no product designer or engineer
can afford not to know them

Visualize a group of materials so universal in scope that they may be used as tough, colorful coatings on paper, cloth, or metal; cast into life-like artificial foliage; molded into a host of articles ranging from dolls, duck decoys, and industrial components to one-piece hobby horses (see Figs. 1 and 2, above); or made into resilient, durable joints for clay pipe. There you have the vinyl plastisols—probably one of the most versatile groups of materials in the entire

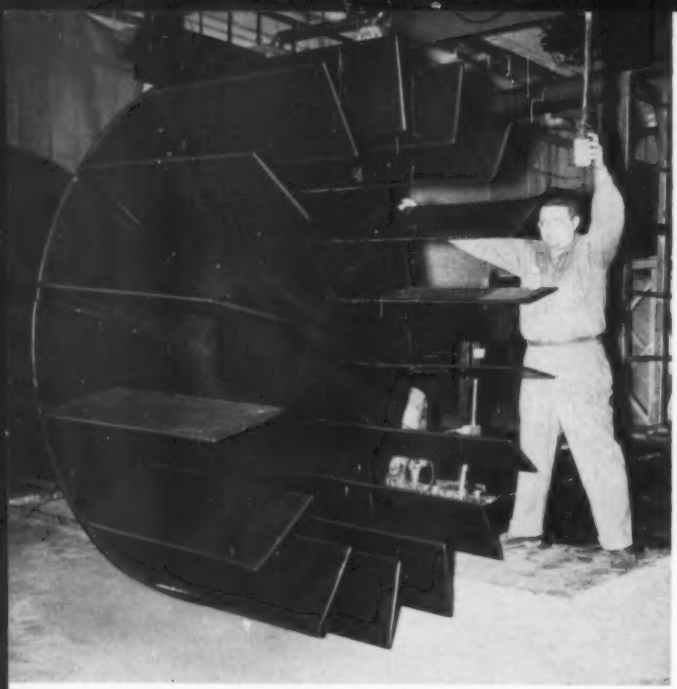


Fig. 3: With proper equipment, even metal parts as large as this agitator for a waste disposal system can be dip-coated with a plastisol to protect the parts against corrosion. (Photo, Michigan Chrome & Chemical)

plastics family. Plastisols offer something for everyone—and although present markets for plastisols are large and varied, tomorrow's prospects appear even more promising.

What are plastisols?

Plastisols are vinyl dispersions consisting of a tailored combination of resins and plasticizers, with such other ingredients as stabilizers, pigments, fillers, etc., being added as necessary to suit the specialized requirements of end-uses.

Regardless of how they are applied, however, and the end product involved, plastisols are converted into final form through the application of heat. To obtain maximum physical properties, they must be fused at a temperature of about 350° F. Gas-fired convection and forced-air ovens, as well as radiant and dielectric heating units, are widely used in fusing plastisols.

Much of the versatility of plastisols stems from the fact that they are formulated as easily handled liquids or pastes which may be readily introduced into molds or applied to various materials by dipping, knife-coating, roller-coating, spraying, etc., and through application of heat be converted into final form without the release of solvents (necessary with organosols). This eliminates the necessity of converting the material from solid to viscous form and obviates the need for heavy, expensive molds, since little or no pressure is involved.

Also of interest to manufacturers is the ex-

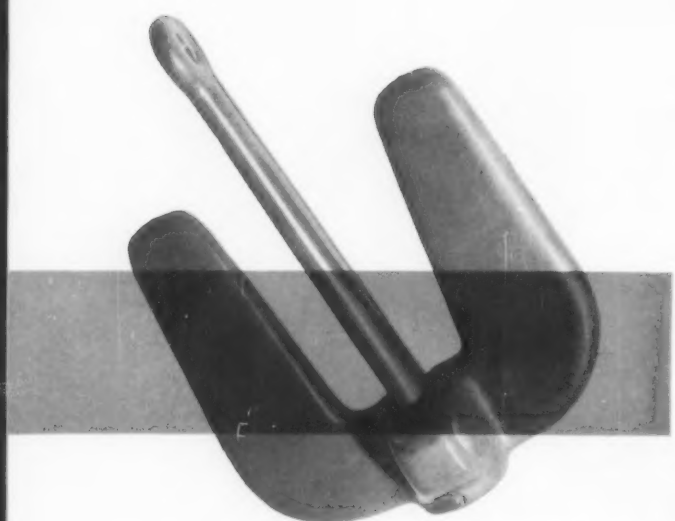


Fig. 4: Dip-coating is also used to provide this 6-lb. marine anchor with a protective plastisol covering that not only resists the ravages of salt water but further serves to cushion contact between boat and anchor and prevent damage to either. (Photo, Monsanto)

Fig. 5: Scissors make use of colorful, cushiony foamed plastisol coating on finger grip to enhance appearance, eliminate "finger fatigue," and protect against perspiration, oil, or grease. (Photo, Bakelite Co.)

ceptional range of properties obtainable by tailoring compounds. Finished plastisol products may be soft and flexible, or very rigid.

Although plastisols are often used by themselves, many of their important applications are in combination with paper, cloth, metal, and other basic materials. In such applications, they contribute surface texture, color, a pleasant touch, corrosion resistance, and resistance to scuffing.

The recent formation of a Vinyl Dispersions Div. of the Society of the Plastics Industry, Inc., further emphasizes the fact that this rapidly growing phase of the plastics industry is coming of age. One of the current activities of this new division is a basic study pointing the way to standardization in the dispersions field.

Basic ingredients

The *plasticizer,* as the sole dispersing medium of the plastisol, largely determines the flow properties of a vinyl paste system, as well as the flexibility, low temperature properties, and odor and migration characteristics of the finished product. Secondary plasticizers are frequently used in the formulation to lower compound cost or impart some particular quality, such as resistance to migration. Thermosetting polymers and nitrile rubber are two materials useful as plasticizers for some special applications. Liquid thermosetting plasticizers, such as dimethacrylate monomers, polymerize during fusion. They are used to achieve finished products that are appreciably harder and have high softening points.

Stabilizers are usually included in plastisol formulations to minimize heat and light deterioration. Representative stabilizers include lead compounds, commonly used in opaque plastisols for both heat and light stability, and tin complexes or barium-cadmium-chelating-epoxy systems, which are employed in clear compounds. Normally, solid stabilizers are dispersed in a small amount of plasticizer on a three-roll ink mill, then added to the plastisol.

Fillers used in plastisol compounding reduce raw material cost and provide another means of controlling flow properties.

Pigments are usually dispersed in a small amount of plasticizer before being added to the

Fig. 6: Cover, rack supports, and interior of tub in 1957-model dishwasher are all spray-coated with plastisol. A continuous protective film is thus formed from the top ledge of the tub to the bottom flange where the driving mechanism mounts. The interior dishracks are dip-coated with plastisol in another color

Fig. 7: With all possible areas of contact in the dishwasher thus coated, dinnerware placed in the unit is effectively cushioned against damage. The coatings will not become gummy even when exposed to hot water, grease, or detergents. (Photos, G-E)

Fig. 8: Amplifier cover for portable record player (across front of unit above grille) is fabricated from plastisol-coated aluminum sheet stock. (Photo, Motorola)

Fig. 9: Coating soles of canvas shoe covers with plastisol helps prevent spread of radioactive contamination at atomic energy plant. Plastisol provides a tough, abrasionproof surface for covers. (Photo, Goodrich)

compound. Pigment-plasticizer dipsersions are also available for use in plastisol compounding. Dispersions of color pigment, vinyl resin, and plasticizer are available in the form of a dry powder that is simply mixed into the plastisol.

Volatile diluents, such as aromatic and aliphatic hydrocarbons, are sometimes used in plastisols to control weights during dipping and coating operations. They decrease the viscosity of the plastisol and increase the ratio of yield value to viscosity. The amount of diluents used rarely exceeds 20% of the compound weight.

Miscellaneous ingredients used in some formulations include surface active agents, employed in small amounts to lower the initial viscosity of the plastisol, and gelling agents, which are used to produce plastisols having very high viscosity and yield value. The latter are frequently identified as plastigels.

Thus, with literally thousands of combinations of base resin, plasticizers, stabilizers, and other ingredients possible, the compounding of vinyl plastisols has become a highly specialized operation best handled by firms having the necessary equipment and technical know-how.

While it is impossible in an article of this scope to bracket all current applications of vinyl plastisols, the following paragraphs highlight some of the more important application trends in this swiftly advancing field.

Coating industrial equipment

A major outlet for vinyl plastisols is in the form of protective coatings for plating tanks, plating racks, chemical plant ducting, conveyors, and other types of industrial equipment. For such items, the purpose of the coating is to shield the basic metal structure against the ravages of corrosion. Because of the flexibility of the plastic material, even items with intricate contours can be successfully coated by dipping or spraying techniques. Since the coatings will not crack under thermal contraction and expansion, the possibility of damage from mechanical abuse is also reduced. In many cases, even expensive stainless steels and non-ferrous alloys will not resist corrosion as effectively as a correctly formulated plastisol.

Large equipment: Among the companies whose specially tailored dispersions are used in this type of work is Michigan Chrome & Chemical Co., Detroit, Mich. The company also has

Fig. 10: Dip-molding techniques are used to turn out the variety of items shown above —ranging from skirt hanger tips to covers for gasoline filling station nozzles. In dip-molding, the mold is dipped into the plastisol and slowly withdrawn. The skin thus formed is fused in an oven and the finished product stripped off the mold. (Photo, Goodrich)

extensive facilities for applying the coatings, including an 8-ft.-deep tank that can hold more (see Fig. 3, p. 104).

In a typical dip-coating application at this plant, the metal part is first cleaned and prime-coated by a spray process, followed by baking to cure the prime coat. Next, the part is suspended by an overhead hoist and lowered into the tank of plastisol, which is at room temperature. The part is then lifted from the tank, allowed to drain, and returned to the oven for final cure of the plastic coating.

One of the over-size products which have been thus coated with Michigan Chrome's Miccrosol Geon-based resins is a large paddle wheel used as an agitator in a waste disposal system (see Fig. 3, p. 104).

Duct systems: Sections of metallic exhaust

Fig. 11: Doll components are produced on three-spindle rotational molding machine designed for speedy production. Formulation, prepared in a 2000-gal. tank, is piped to storage tanks and withdrawn as needed. (Photo, Goodyear)

Fig. 12: New commercial application for rigid plastisols (harder than conventional formulations) is a compact, rotationally molded battery service kit. Lightweight but rugged, the kit is not damaged by battery acid, grease, or oil. (Photo, Goodrich)

Fig. 13: Typical industrial application is a coating for fan housing to be used in corrosive atmospheres. (Photo, Michigan Chrome)

Fig. 14: Other industrial applications include flexible plastisol gaskets. In this dry filter for an auto air cleaner, the snug gaskets on top and bottom also serve to unify assembly. Filter can be tapped against foot to clean out dust. (Photo, Chrysler)

Fig. 15: Model of human heart (designed to be used for medical purposes) is rotationally molded of a rigid vinyl plastisol so tough it can bear the weight of a man without breaking. (Photo, Plastic Rotocast)

duct systems lend themselves to plastisol protective coating by the dip method and are in use in many industrial plants.

Plating equipment: Highly corrosive solutions used in the electroplating of metal parts require protective linings in the plating tanks. Vinyl plastisols have moved heavily into this field. In a new bumper plant recently built by one of the major automotive manufacturers, involving 750 ft. of plating tanks, approximately 85% of the tank area is plastisol-coated. The plastisol-coating work on this installation, performed by Udylite Corp., Detroit, Mich., using Miccrosol vinyl plastisols, included one tank measuring 33 ft. long, more than 9 ft. wide, and 8 ft. deep. Coating of this unit was handled by spray rather than dip application. The ability to coat such large structures eliminates the problem of seams encountered with sheet-membrane-type coatings.

Parts-handling equipment: Another important industrial use is to provide a resilient surface material-handling equipment, to protect metal parts against damage while being carried through manufacturing operations. In the Tyler, Tex., plant of General Electric Co., for example, a refrigerator base panel carrier used to transport painted panels makes use of the cushioning properties of dip-applied plastisol to prevent marring or scratching of the panels. Formerly, the carriers were wrapped with tape, or slit sections of rubber hose were applied to shield the parts against damage.

Miscellaneous: Indicative of the current diversity in plastisol-coated applications are two of the more unusual products: a marine anchor produced by Whitman & Robinson Co., Weedsport, N. Y., and dip-coated with a plastisol based on Monsanto's Opalon 410 vinyl paste resin (see Fig. 4, p. 104) and a new line of Cushion-Grip scissors and shears produced by John Ahlbin and Sons, Inc., Bridgeport, Conn., with handles coated with a foamed plastisol based on Bakelite vinyl resins (see Fig. 5, p. 104).

Strip-off coatings: Specialized types of plastisol coatings now available to manufacturers include strip-off coatings for pro- (*To page* 225)

Flow properties required for molding intricate polyethylene pieces can be more closely controlled by adding low-molecular-weight material. (Photo, Beacon Plastics Co.)

*By Karl F. Koch**
*and Jack Peck**

Why low-molecular-weight polyethylene?

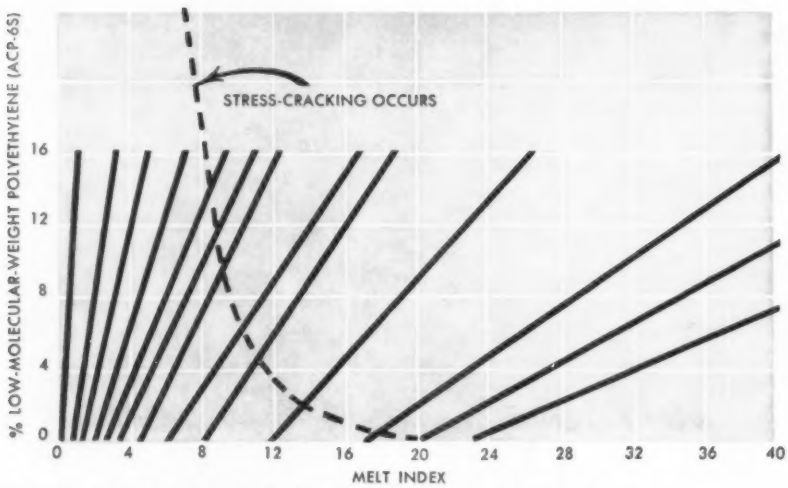
The combination of low-molecular-weight polyethylene, e.g., A-C polyethylene 6S[1], with high-molecular-weight polyethylene has, in many instances, proven to be the solution to some of the general molding problems now encountered when using high-molecular-weight polyethylene alone. Flow problems and faulty color dispersions, for example, rank high among the list of common molding ills that can be cured by the combination. High gloss and superior mold release are also easy to obtain in highly polished molds when using the blend, and in most applications, the physical properties of the end-product, e.g., tensile strength, elongation, etc., can be maintained within practical limits.

Flow problems solved

Because of the differences between the various ways in which polyethylenes are manufactured, a wide variety of viscosities has resulted among these polyethylenes, even though their melt index at 190° C. is the same. In other words, the slopes of the curves vary from polymer to polymer even though they may cross on a graph at 190° C., giving the same melt index. In order, therefore, to make the viscosity of a given polymer satisfactory for molding, it is

A-C polyethylene 6S, on which this report is based, is an inert low-molecular-weight polymer of ethylene available in uniform cubes or powder form and in hot-melt or water-emulsifiable grades from Semet-Solvay Petrochemical Div., Allied Chemical & Dye Corp. Already noted for its use in paper coatings and in paints, inks, and varnishes, the material is reportedly now finding increased volume use as an additive for standard polyethylenes. In this report, a team of Allied researchers review why they feel it has application in the injection molding field and how it can best be used.

*Group staff, Research and Development, Semet-Solvay Petrochemical Div., Allied Chemical & Dye Corp.
[1]A product of Semet-Solvay Petrochemical Div.



Graph 1: Melt indices will change when low-molecular-weight polyethylene is added to different high-molecular-weight materials

often necessary to "tailor" the flow characteristics of the polymer in a manner which will give it the qualities necessary for the specific molding application.

One of the ways in which the tailoring of flow characteristics can be achieved is by dry-blending low-molecular-weight polyethylene with the high-molecular-weight material before loading the hopper. Graph 1, above, shows the results of adding the low-molecular-weight material to a variety of polyethylenes with different melt indices. The slopes of the curves decrease as the melt index of the virgin polyethylene increases. Normally, the addition of 10% low-molecular-weight polyethylene to a given polyethylene will double the latter's original melt index. A marked change in the slope of the melt index curve takes place when about 15 to 18% low-molecular-weight material is added, and from that point on, the melt index increases rapidly.

By thus using low-molecular-weight material in combination with a selected high-molecular-weight polyethylene, the molder can tailor a resin to meet lower viscosity specifications and consequently to facilitate mold fill-out—without the danger of at the same time imparting any undesirable characteristics to the finished product.

Stress-cracking

Stress-cracking problems have received more than their share of publicity. The basic polyethylene resins have varying degrees of resistance to stress-cracking and the injection molding process is one which introduces other variables.

It has been found that blending low-molecular-weight polyethylene with a lower melt index resin to reproduce the viscosity of the base polyethylene originally intended for the application will help improve resistance to stress-cracking. An object molded of polyethylene with a melt index of 8, for example, will have fair-to-poor stress-cracking properties; the same object molded from a blend of polyethylene with a melt index of 2 and moderate amounts of low-molecular-weight polyethylene will mold

Low-molecular-weight polyethylene can be used in blends to improve surface gloss of the finished molded product. (Photos, Beacon)

easier. It will, in addition, have at least as good, and possibly better, resistance to stress-cracking.

Color dispersion

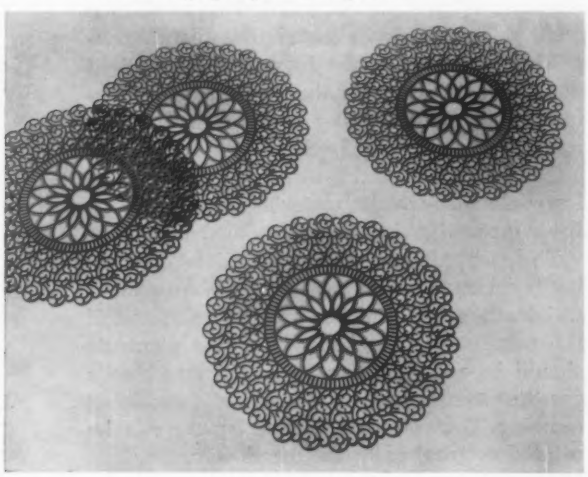
Good color dispersion for the average molder is a problem which cannot be overlooked. The use of mechanical aids generally helps to disperse the colorant, but low-molecular-weight polyethylene can also be put to work to help the process along. As the polyethylene plus the colorant plasticizes in the barrel of the injection molding machine, the color is first evenly distributed in the lower-molecular-weight material. This material then carries the colorant into the higher-molecular-weight polymer to make for a more even distribution.

The particle size of a colorant, of course, also plays an important role in determining just how well it can be dispersed, but the color manufacturers are minimizing this problem.

Glossy surface

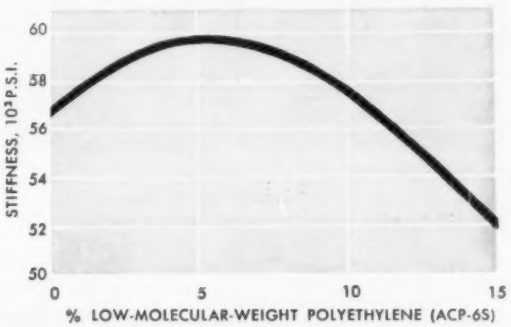
In addition to good color dispersion, the low-molecular-weight material can also help in obtaining a high gloss. Normally, high-molecular-weight polyethylene does not release readily from a polished mold. Most molds, therefore, have been vapor-honed to give good release and produce a satin finish. This finish has become the accepted surface for a polyethylene product, although many customers desire a high gloss instead. This high gloss, as well as good mold release from highly polished molds, has been obtained by blending in the low-molecular-weight material. It should be noted, of course, that the finish on the end-product will still be only as good as the surface of the mold.

Color dispersion, as in molding these intricate doilies, is said to be improved by using a blended polyethylene compound

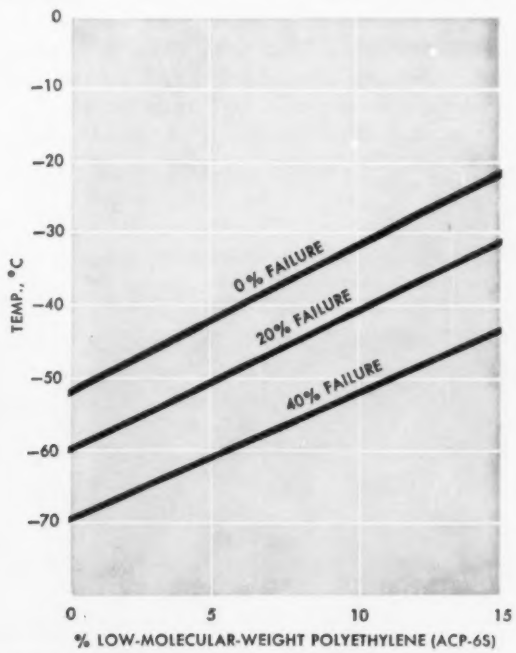


Lower pressure, shorter cycles

The lower injection molding pressures required when using low-molecular-weight polyethylene allows a mold to be filled rapidly and does not overtax the hydraulic system of the machine. This rapid filling is most desirable,



Graph 2: Stiffness can be increased with the addition of small amounts of low-molecular-weight polyethylene



Graph 3: Data on brittleness-temperature changes were obtained from injection molded test bars. (Graphs, Semet-Solvay)

Rapid mold fill-out, even for large pieces, is claimed as an advantage for blends of low- and high-molecular-weight materials

since it allows a more uniform part to be produced. The polymer reaches every part of the mold at a more uniform temperature without additional pressure. The pressures required are at the lower end of the gage, often ½ the former working pressure. The decreased pressure should also benefit machine maintenance.

Shorter cycles have been noted in a great many commercial operations involving the low-molecular-weight polyethylene as an additive. As much as 35% increased production has been achieved. The features of good mold release, low injection pressure, and fast filling time for the mold have all contributed to the reduced cycle time.

Working pressures required for molding most typical polyethylene pieces can also be reduced by using a blend. (Photos, Beacon)

Property changes

The tensile strength of blends of low-molecular-weight with high-molecular-weight polyethylenes seems to be proportional to polymers of similar melt indices. It is hard to differentiate between tensile strength of a 5% blend and that of virgin polyethylene. Ten percent blends show a slight decrease in tensile strength, but not enough to cause concern in an average application. It is normally agreed that the higher melt index polyethylenes do not have tensile strengths as high as low melt index polymers.

The percentage elongation of a 5% blend is about 25% greater than the virgin polyethylene. The 10% blend has an elongation slightly less than the 5% blend and the 15% blend is similar in elongation characteristics to virgin polyethylene.

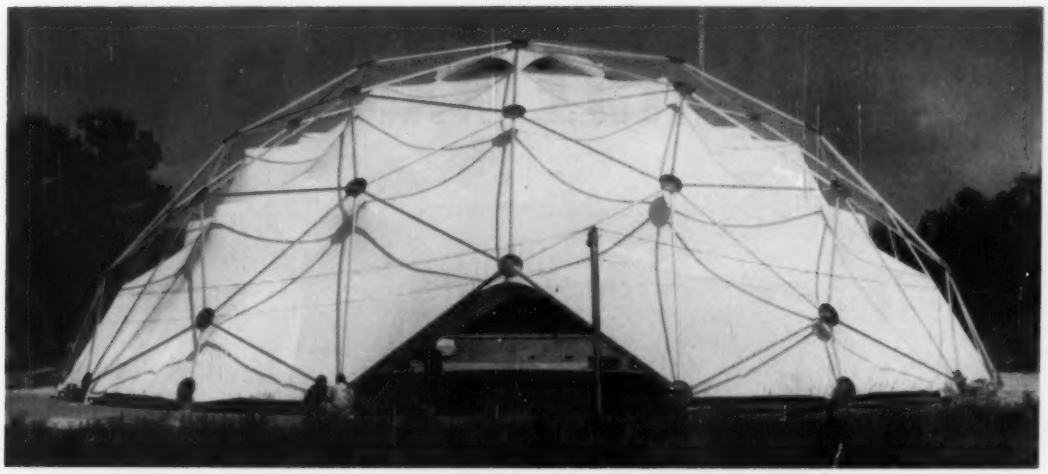
The addition of small amounts of low-molecular-weight polyethylene causes an increase in stiffness. Percentages in the region of 15 to 20% begin to cause a decrease in stiffness. (See Graph 2, p. 111.)

Brittleness temperatures are of interest in special applications where the objects are to be subjected to low-temperature environment. It was found that about 40% failure was recorded for normal polyethylene of melt index 2 at −64° C. A 5% blend with the same polyethylene had 40% failure at −70° C. The 10% blend gave a 40% failure at −52° C., while a 15% blend gave 40% failure at −43° C. (See Graph 3, p. 111.) The data were recorded from injection molded test bars.

The shrinkage of molded parts was also checked, using disks and tensile bars of various widths. The check indicated that blends containing 5 or 10% of the low-molecular-weight material with commercial polyethylene (with a melt index of 2) offered more control of shrinkage than the virgin polyethylene.

The hardness of the blends containing the low-molecular-weight material remains about the same as the virgin polyethylene.

The preparation of blends for injection molding involves only the weighing of the two materials, then tumbling for about 15 minutes. If the polymers are to be colored, the pigments should be added at this time. The dry blends are then used directly in the injection molding machine. Tests indicate molded parts can be printed or marked in the usual way.



Geodesic structure using vinyl-coated nylon has been called "the first major improvement in mobile military shelters in the past 2600 years." (Photos, Geodesics, Inc.)

Tomorrow's tent

Geodesic domes of vinyl-coated nylon fabric and aluminum framework have been reported by the Marine Corps to weigh about ¼ as much as an equivalent amount of conventional shelter material; take up approximately $\frac{1}{7}$ of the packaged volume; cost about $\frac{1}{6}$ as much; and require less than $\frac{1}{8}$ of the man-hours to cover the same amount of enclosed square feet of floor space.

This means that total annual savings by the Marine Corps alone would amount to 122 million lb., over $3\frac{1}{10}$ million cu. ft. of shipping volume, $45 million, and $3\frac{1}{2}$ million man-hours.

Officially termed "the first major basic improvement in mobile military shelters in the past 2600 years," the structures are slated to replace all of the tents now being used by Marine Aviation.

The geodesic dome—"geodesic" means the shortest line between points on the surface of a sphere—is the brainchild of R. Buckminster Fuller, engineer-inventor-architect, who designed and holds patents on it, and is president of Geodesics, Inc., Raleigh, N.C.

The material used in the new military shelters is 2.4- and 3.9-oz./sq. yd. nylon coated with vinyl to finish weights of 6.5-, 10-, and 12-oz./sq. yd. All seams and vertex support points are heat-sealed. Cemented sections are used only to provide water seals at vertex locations.

Credits: Manufactured by Irving Air Chute Co., Lexington, Ky., and Domestic Film Products Corp., Millersburg, Ohio. Welkote nylon by Wellington Sears Co., New York, N.Y. Coating based on Geon vinyl resins by B. F. Goodrich Chemical Co., Cleveland, Ohio.

View of tent just prior to final tightening adjustments. Stress will be equalized in all directions and cloth will be wrinkle-free

VERSATILE WAREHOUSING

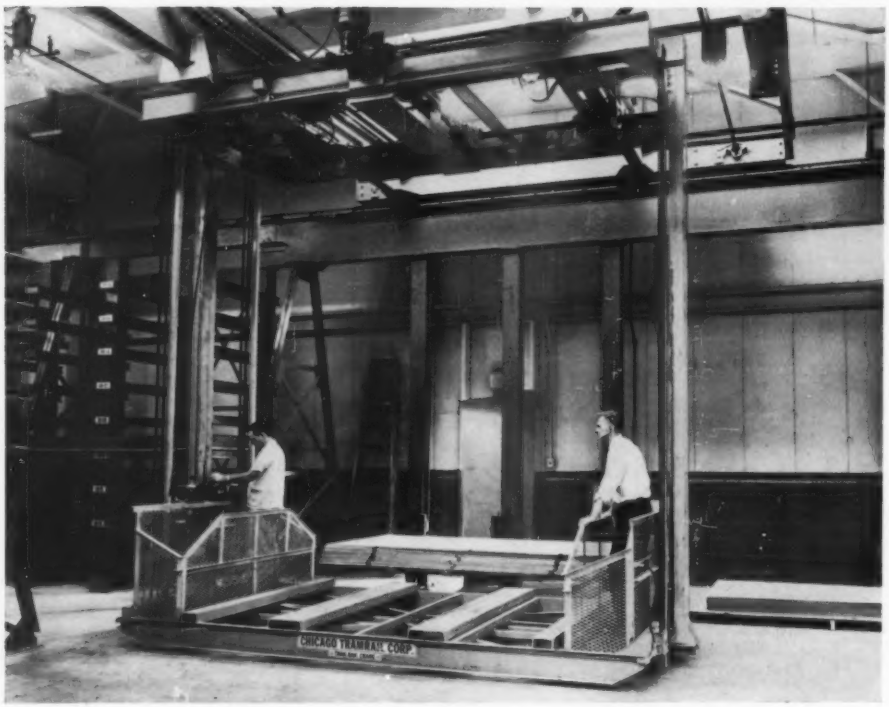


Fig. 1: Two-man order-assembly crane. Inverted channels on base support load and provide clearance for unloading by a fork-lift truck. (Photos, Formica Corp.)

Fast, efficient warehousing of plastics sheets is achieved at Formica by a new installation combining special overhead cranes and pallet storage racks. The new crane-rack system has made possible a four-fold increase in storage capacity with only a one-third increase in floor space. In addition, the new set-up handles two to three times the previous volume of orders from stock with less personnel than the old method of pallet-on-floor storage.

The new handling system, increasing the amount of material stocked for customer orders, results in economies in production and improved deliveries. The new warehouse area handles up to 10,000 sheets per day and provides separate storage space for 600 pattern-size combinations of the company's decorative surfacing material. Capacity is 160,000 sheets.

The cranes, racks, and pallet boards function as an integrated system for the handling of bulky sheet stock. Two different types of overhead cranes are used. A two-man platform crane provides for assembling stacks of sheets to fill customer orders. A one-man fork-lift crane is used for moving new stock into the storage area. The special storage racks support the crane rails and supplement the crane designs in aisle arrangement and shelf spacing. Both cranes and racks use ¾-in. plywood boards in place of conventional pallets. The entire crane rack system was built and installed by Chicago Tramrail Corp. in cooperation with Formica engineers.

Order-assembly crane

The order-assembly crane (Fig. 1) operates as a mobile elevator platform onto which sheets are pulled by hand from the sheet storage

Crane-rack system handles 10,000 sheets of plastics laminate a day, with startling savings in labor and costs

*By O. Sommers Hagerman, Jr.**

racks. To provide access to all parts of the storage area, the crane moves in any of three directions. A main supporting bridge clears the top of the storage racks and rides on rails running parallel with the main storage aisles. A secondary trolley bridge moves at right angles to the storage aisles and is suspended from the main bridge by a four-cornered monorail arrangement. The load-carrying platform moves up and down (Fig. 2) and is supported at its corners by chains hung from the trolley bridge. The platform is stabilized at each end by roller assemblies which guide on the two rigid columns hung from the trolley bridge.

Operation of the order-assembly crane is controlled by one man who directs the unit at speeds up to 200 ft./min. along the aisle. A second man assists in handling the plywood pallet-board and stacking the sheets which vary in size up to 4 by 10 feet.

Storage crane

The special fork-lift storage crane (Figs. 3 and 4) is designed for a 6000-lb. maximum load and is operated by one man who rides or walks with the unit as it operates. The unit is equipped with four forks spaced on 2-ft. centers to match storage rack spacing. This arrangement provides extra load capacity and minimizes flexing of the long pallet boards and loads of sheet stock.

The double-column support on which the forks move up and down can be rotated to orient the load in any desired direction. Since aisle widths are only 8 ft., loads must be faced correctly before entering the aisle. Suspension features are the same as those for the order-assembly crane, permitting movement along and at right angles to the storage aisles.

Storage racks

The special sheet storage racks provide high load capacity and efficient use of vertical space. Designed for maximum loads of 3000 lb., the racks are constructed of 4-in. steel channels welded in pairs to 8-in. I-beams (Figs. 3 and 4). Each pair of channels makes a single rack "arm" which extends out 54 in. from its sup-

*Methods engineer, Formica Corp. (a unit of American Cyanamid Co.)

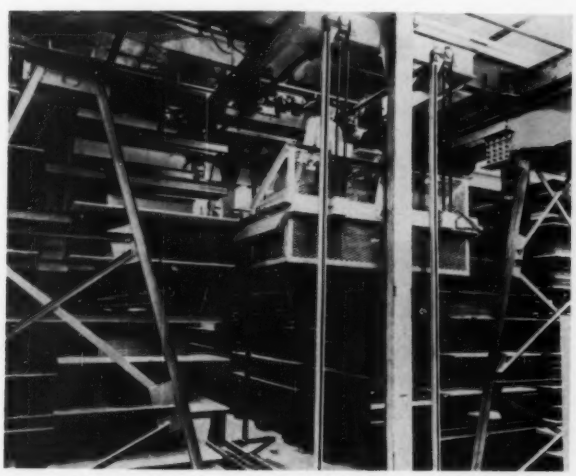


Fig. 2: Pulling sheets to fill order. Order-assembly crane is positioned at working height at proper rack opening. Close clearance between rack and crane minimizes reaching

Fig. 3: Over-all view of storage area, with decorative surfacing materials in racks. Cranes—fork-lift (left) and order-assembly (right)—can be moved to service either aisle

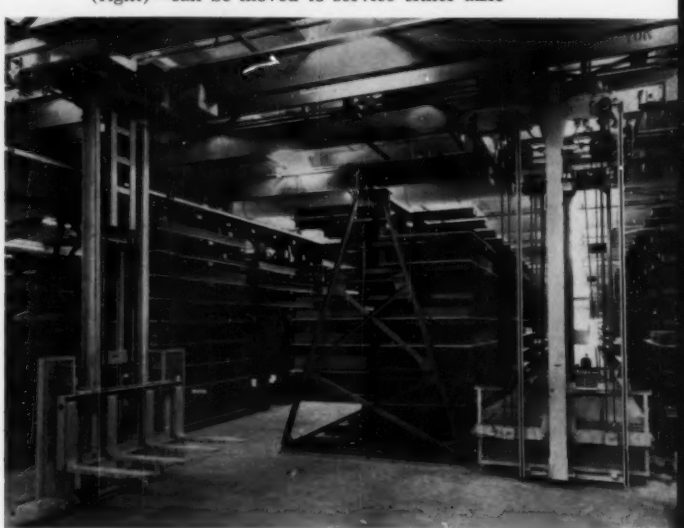


Fig. 4: Moving new stock into storage with fork-lift crane. Combination of racks and overhead cranes permits narrow aisles and full use of vertical space for storage

porting column. Columns are spaced every 4 ft. and braced at intervals by special A-frame assemblies. A group of three arms makes up a single rack opening for 8- or 10-ft.-long sheets. Two arms are used for 6- and 7-ft. sheets.

Vertical space from the floor to the top of the storage racks is divided into nine openings. Each of the eight upper openings will hold 140 to 150 $\frac{1}{16}$-in. sheets plus the $\frac{3}{4}$-in. plywood board on which they are stacked. A ninth opening at floor-level provides additional space for large-volume items. The use of $\frac{3}{4}$-in. boards in place of pallets increases the capacity of each rack opening by 75 sheets.

The complete storage area consists of four parallel aisles serviced by two order-assembly cranes and two storage cranes. Each aisle is 160 ft. long and 8 ft. wide. Over 1000 rack openings are included.

Order assembly

Each load of sheets pulled from the storage racks is carefully planned in advance to meet final processing and shipping requirements and to insure efficient utilization of the crane equipment. Since the sheets stocked are in a semi-finished condition, the orders making up a load are first selected to contain only sheets which will follow the same finishing routing. The orders are then grouped according to the sizes accessible to each order-assembly crane and also grouped by customer to simplify later packaging. Finally, the sequence in which the sheets are pulled is set up to minimize the amount of crane travel.

After a load of sheets is assembled, the crane is brought to the head of the storage aisle where the load is removed by a fork truck or by positioning the crane platform over a set of stationary forks mounted on a column. The load is then transferred onto a large flat-bed truck for movement to the finishing department.

Replenishing stock

A steady flow of incoming stock loads is received around the clock. These loads are stacked at one end of the crane area where they can be picked up by the storage crane without rehandling. The stock is received already palletized on the same $\frac{3}{4}$-in. plywood boards on which it will be stored. These palletized loads are separated by 2-by-4's to permit entry of the storage crane forks.

Since the order-assembly and storage cranes share the same crane rails, incoming stock is put away only when the order-filling operations are shut down, usually at night. The majority of items stocked are assigned two rack openings and the order points for additional stock are set so that one of the two rack openings will be available to receive the new stock when it comes in. Before any loads are put away, two men on the order-assembly crane make a trip through each aisle to remove empty pallet boards.

Safety

Both personnel and equipment have received special attention to assure safe operation. Only licensed crane operators are allowed to run the crane equipment. To qualify for a license, each operator must pass a special physical examination and attend a formal instruction course stressing safe practices.

On the order-assembly cranes, a safety interlock prevents movement unless both men are in a safe position. Special limit switches also prevent entry into an aisle or crossover unless safe clearances are established. On the storage cranes spilled sheets are prevented by an indicator light which shows when the forks are at the correct level for moving a load into the racks.

Installation of the crane-rack equipment has enabled Formica to set up a greatly improved warehousing operation. At the same time, an estimated $350,000 has been saved in the additional labor and building costs which would have been required to expand stock operations using previous handling methods. The new system has been operating successfully for over six months during which time over 800,000 sheets of decorative surfacing material have been processed.

For boat or car

Major components of compass are molded of butyrate and acrylic

Pointing the way towards achieving clean, functional styling through a sound use of plastics materials, a new self-illuminating navigation compass heads in the right direction with a simple design based on seven plastics parts—four components molded of butyrate and three components, including the dome through which the compass is read, molded of crystal clear acrylic.

The main housing of the compass, a housing for a light bulb and a dry cell, and the bottom plate of the compass, which also houses two compensation magnets, are all injection molded of lustrous, tough butyrate. Three threaded holes tapped into the rear of the main housing after molding accommodate the screws used to attach the adjustable bracket on which the compass is mounted. Similarly, two threaded holes are tapped into the molded bottom plate for the two screws which may be turned to adjust the compensation magnets. All lugs, bosses, slots, etc., required for assembly of the three parts are molded in.

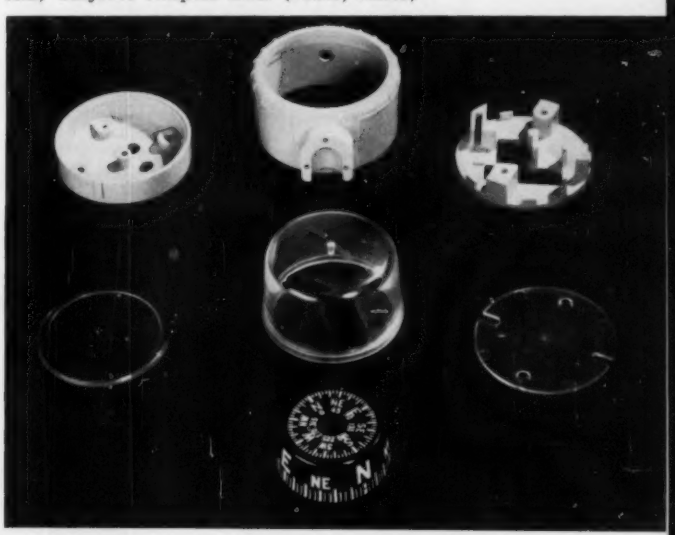
The fourth butyrate piece is the black compass card. This particular piece represents an especially tricky job in decorative marking, since a peripheral hot-stamping operation was required for the outside surface of the card (which is in the shape of a cone frustum) while a conventional flat hot-stamping operation was used for the top flat surface.

The clear acrylic dome, which has a red arrow on its top outside surface and a red line on its peripheral face, also involved a tricky hot-stamping operation. The other two acrylic parts in the compass are the flat bearing plate crystal and the flat dome plate—both also molded of clear material.

Thanks to the toughness and corrosion-resistance of the plastics components, the compass can be used in cars or boats to provide fully compensated, easy-to-read directions. Inside the liquid-filled dome, the dial tilts 20 degrees without binding and gives a smooth, steady indication. Pressing a push button on the case lights the dial for night use.

Compass for marine and automotive use is designed around crystal-clear acrylic and tough, corrosionproof butyrate components. (Photo, Eastman Chemical Products, Inc.)

Credits: Molded for Taylor Instrument Cos., Rochester, N. Y., by Nosco Plastics, Inc., Erie, Pa., using Tenite butyrate supplied by Eastman Chemical Products, Inc.



Plastics parts include: (top) butyrate bottom plate, main housing, and light-bulb housing; (center) acrylic crystals and dome; (bottom) butyrate compass card. (Photo, Nosco)

Several materials, many techniques

are used in the making of

PLASTICS LENSES

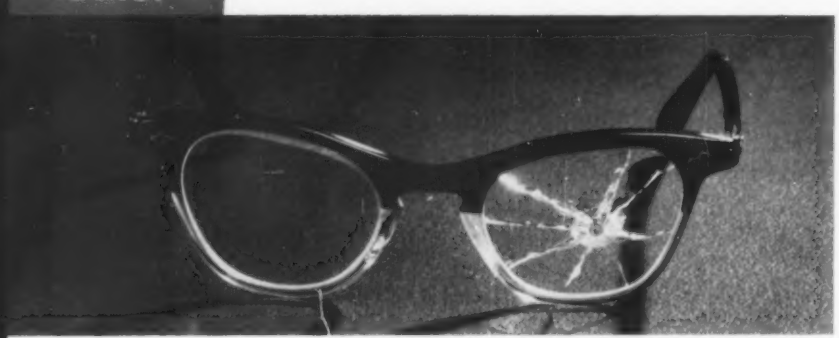
*By Dr. L. D. Bronson**

In the past ten years, a revolution has taken place in the lens field: Hard plastics resins have emerged as major materials in the manufacture of lenses that are safer and lighter in weight, as well as more efficient than conventional glass lenses.

By definition, a lens is a transparent medium with the power to bend rays of light. Lenses are classified into two principal groups: 1) the ophthalmic group—those lenses employed for the correction of visual errors (e.g., spectacle lenses); and 2) the precision lens group—those produced for industrial, scientific, or military use, primarily in measuring and detecting devices. More recently, lenses in a third group—contact lenses and telescopic

*Director: Opto-Medical Research Laboratories, Jamaica, N.Y., an organization devoted to developmental work in the field of scientific optics and optics as related to the human eye.

Safer



Pair of test glasses at left was subjected to impact by flying particles of equal weight and momentum: the glass lens at right cracked, while the plastic lens remained intact and unmarked

More durable

Shower of small particles from grinding wheel did not damage plastic lens (left), but surface of glass lens (right) was badly scarred

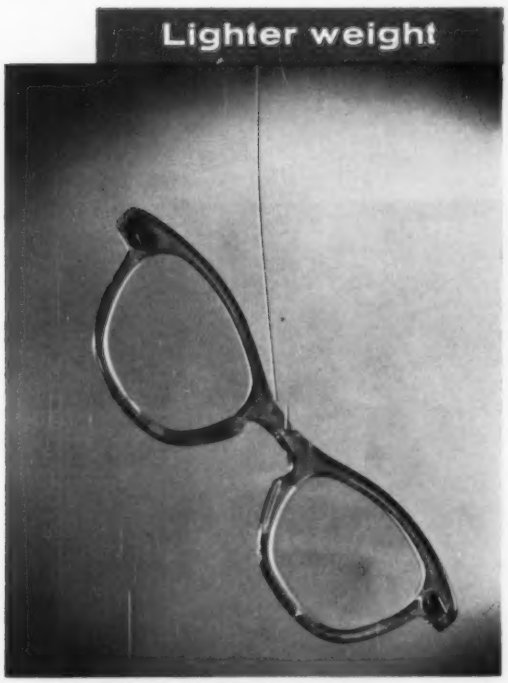
spectacles—have come into prominence, but their use is still highly specialized and they have limited application.

Plastics vs. glass

Until only a relatively few years ago, glass was the *only* lens medium available. Then plastics appeared on the scene to signal the first major change in centuries of lens construction. If a plastics lens could be produced at a price comparable to glass it would replace glass entirely, since plastics have the functional characteristics of glass while offering distinct advantages such as greater safety, lighter weight, more versatility, improved light transmission, and ultra-violet light absorption.

Plastics compositions can be formulated to meet all the requirements of a particular type of lens. It is possible to treat some plastics, for example, so that they transmit the visible spectrum unimpaired but are entirely opaque to ultra-violet. On the other hand, if ultra-violet light transmission is desired, several thermoplastics are available that can be formulated to offer this property.

Safety, however, is probably the most important advantage of plastics lenses. In the United States, an eye accident occurs every 30 sec. of the working day. Every day of the working year, 26,800 workers are idle because of eye injuries. Approximately 1000 American workers each year lose the sight of one eye irreparably and 100 more lose the sight of both eyes. Many such eye injuries could have been prevented by taking advantage of the excellent eye protection which tough plastics lenses can offer.



Plastic lens in left half of spectacles is much lighter than glass in right half, as shown by balancing demonstration

Selecting the plastic

Plastics lenses must possess a certain minimum of chemical, physical, and optical properties. Homogeneity should be consistent; the lenses should possess the utmost resistance to water absorption; and they should have structural and surface hardness. Consideration should also be given to softening temperature, heat resistance, solubility in common solvents, general stability and workability, absence of color, weatherability, ultra-violet stability, toughness, abrasion resistance, and other characteristics which might have a bearing upon serviceability. In addition, the ophthalmic plastics must be non-toxic to human tissue, free of offensive odors, and impervious to deterioration by perspiration.

Individually, of course, each plastic has special characteristics to offer in the design of a particular lens. Suitable lenses have already been produced successfully from a number of different formulations. The plastics most commonly used for lenses are the acrylics, cellulose acetate, styrene, vinyls, polyesters, and the allyl compounds. (See Table I, p. 121.)

Acrylics

The acrylics as lens materials have the greatest resistance to effects of sunlight and outdoor weathering. They are chemically inert, stable, and non-toxic to human tissues. They are flexible and shatter-resistant. The smoothness of surface and the clarity of the cast material are superior to those of drawn silica glass.

Although acrylics are harder than most transparent plastics, they still have poor scratch resistance and poor impact resistance. In this latter regard, however, they are superior to glass.

The use of methyl methacrylate as a basic material for lenses has been so substantial that nearly every form of lens has been fabricated from it using every known method or technique. As one example, Brilhart Plastics Corp., Mineola, N. Y., has molded a series of fine

acrylic finder lenses which have found successful use in reflex cameras. These lenses are injection molded from a special acrylic formulation in chrome-plated, four-cavity molds.

In another type of unusual lens application, a crystal-clear acrylic lens machined from preshaped sheet stock is being researched for medical use. The acrylic lens is intended to be implanted into the anterior chamber of the human eye to replace and simulate the function of a human crystalline lens which has been removed by cataract surgery. Although the technique is relatively new and still not common, there is high hope for it as a possible replacement for the thick, cumbersome, and not too effective spectacle lenses that now have to be worn by patients after such surgery.

Cellulose acetate

Although there are several techniques for handling cellulose acetate, the material is most usually injection molded into low-cost commercial lenses. Depending upon the surface quality of the mold being used, these lenses can be turned out with a smooth surface finish. Caution, of course, must be exercised in molding to avoid flow marks, crazing, and hazing. The material softens at the relatively low temperature of 150° F. and is non-flammable. Its hardness, toughness, color, and other properties vary depending upon the plasticizers, dyes, and pigments used in the formulation. Acetate scratches easily, but this is not a serious drawback in many applications.

Styrene

Substantially hard and rigid (it does not soften until temperature approaches 200° F.), colorless, and quite transparent, polystyrene can be compression molded into strain-free lenses. Styrene lenses can also be made by injection molding and casting. Because the material is readily attacked by most organic solvents, such as acetone, its usefulness in ophthalmic lens work is limited. Nevertheless, it can be and is used extensively for scientific lens elements which are not exposed to handling. Styrene is important in large lenses, such as those used in telescopes, because of its hardness and other desirable properties.

During World War II, our government realized that we were not geared to mass-produce precision glass lens elements for gun-sights, range-finders, aerial cameras, and a host of other military instruments. In seeking a solution to the problem, plastics were investigated and, as a result, a method was developed for casting plastics optical elements with precision

Fine grinding is done in multiple grinding pots, which operator sets up by placing mounted lens in position and lowering weight

Easy to fabricate

Allyl lenses are shaped by automatic machine using templets, some of which are shown on paper in foreground. (Photos, Opto-Medical)

Table I: Plastics lens manufacturers[a]

Manufacturer	*End use[b] of lens*	*Trade name*	*Material[c]*	*Technique[d]*
American Optical Co., Southbridge, Mass.	1, 2, 3	Plasticor	2, 4	I, S
Armorlite Corp., Pasadena, Calif.	1, 3, 4	Armorlites	2, 4	S, G
Brilhart Plastics Corp., Mineola, N. Y.	5	—	2	I
Cast Optics Corp., Hackensack, N. J.	2	Cocor	2, 4, 5	S
Chicago Eye Shield Co., Chicago, Ill.	2	Crescolite Perma-clear	2, 4, 8	I, S
Combined Optical Industries, Ltd. London, England	3, 4	Igard	2, 3, 7	L, S
Eastman Kodak Co., Rochester, N. Y.	5	Fresnol	6	P
Feinbloom, Dr. W. New York, N. Y.	1	—	2, 4	L, S, G
Fluidless Contact Lens Co., Detroit, Mich.	1	Airflow	2	L, G
Lever Optical Co., Ltd.[e] London, Eng.	2, 3	Tophlite	8	S
Optics Manufacture Corp., Philadelphia, Pa.	5	—	2	I, S
Parmlee Co., F. Kansas City, Mo.	2, 3	Optilite	2, 4	I, S
Perkin-Elmer Corp., Norwalk, Conn.	4	—	1, 8	G
Pioneer Scientific Corp., Great Neck, N. Y.	2, 3	Enduron	4	S
Plastic Contact Lens Co., Chicago, Ill.	1	Sphercon	2	G
Polaroid Corp., Cambridge, Mass.	4	—	9	S
Polycast Corp., The Stamford, Conn.	2	—	4	S
Queens Bifocal Co.[e] Jamaica, N. Y.	2, 3, 4	Medilens Stereo angle lens Proxifocuser	1, 2, 3, 8 9, 10, 11	I, S, G, P

[a]Data prepared by the author.
[b]1—contact; 2—industrial plano (non focus); 3—opthalmic; 4—precision; 5—commercial
[c]1—acetate; 2—acrylates; 3—acrylate copolymers; 4—allyls; 5—allyl copolymers; 6—butyrate; 7—Focalite (thermoplastic sheet, Peterlite Plastics); 8—M-324 (thermoset resin, Opto-Medical Laboratories); 9—polyester copolymers; 10—polystyrene; 11—vinyl
[d]I—injection molding; L—lathe machining; S—single lens casting; G—grinding and polishing; P—pressing
[e]Licensee Opto-Medical Research Laboratories

surfaces which did not require grinding. A special formulation of polystyrene was used which had an index of refraction similar to that of flint glass.

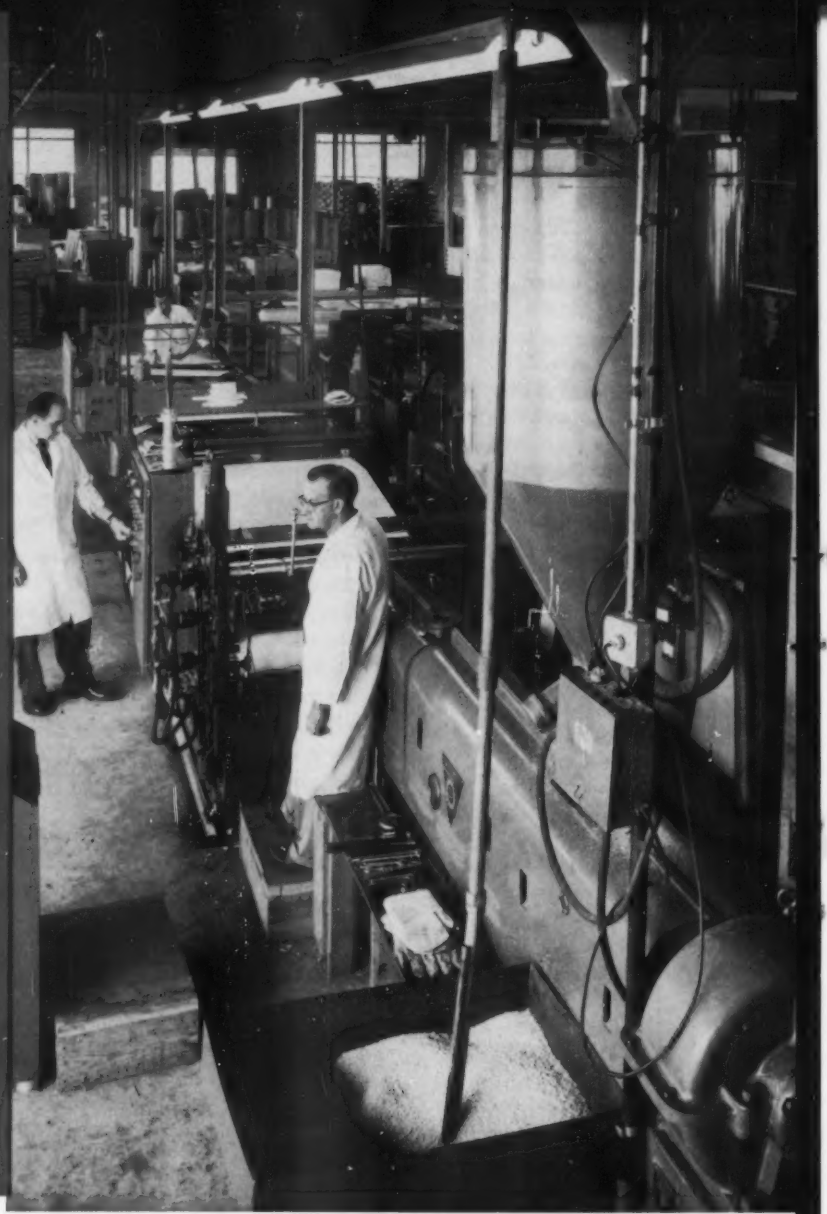
Vinyls

Due to the fact that they have very good properties of flexibility as well as of resiliency, plasticized vinyls have found use as lenses for goggles that are worn by welders, as well as for other safety goggles that are designed to protect the wearer against flying particles. Most vinyls are inherently clear, but have a very low softening point—less than 150° F. Vinyl is also strongly affected by exposure to light, especially when it is uncolored. Vinyl chloride copolymerized with vinyl acetate makes for a versatile material that seems (*To page* 240)

Automated sheet extrusion

By Frank R. Nissel*

In this, the second article in the series "The economics of plastics extrusion," is described in detail the world's newest sheet extrusion plant



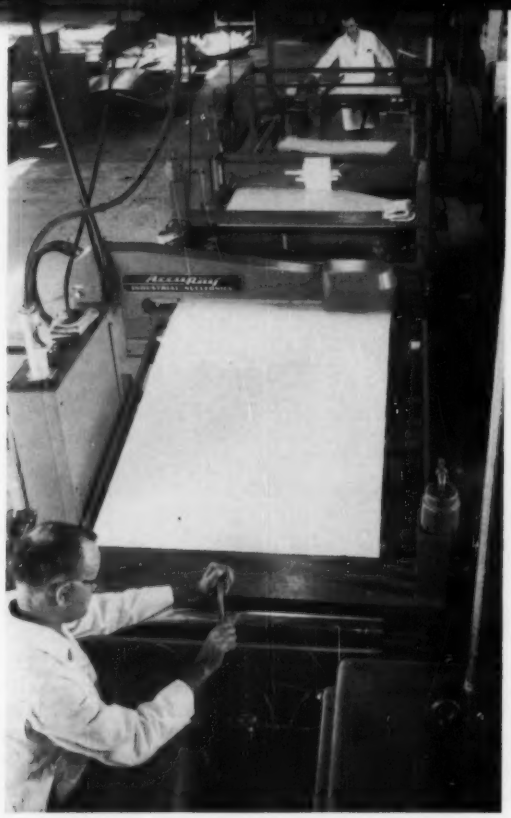
Extruder end of sheet production line, showing hopper dryer in foreground being fed material by air from carton-drum; slit die with heating units and controls; and, at left rear, take-off equipment

The recent trend to fully integrated extrusion installations is probably best exemplified by a view of what is going on in the latest sheet extrusion plants. Perhaps the most advanced such plant in existence has recently been placed in operation at Gaylord Packaging Corp., South Hackensack, N. J., by Prodex Corp. This unit combines the latest extrusion and take-off equipment with continuous beta-ray gaging to produce sheet of outstanding quality and precision at a lower cost than hitherto possible. This installation contains a number of important new developments and refinements. Gaylord is currently blending Monsanto's Lustrex 88 with other styrene alloy formulations to produce a modified sheet declared to have a fast cycle in vacuum forming, high tensile strength, and to make possible deep draws in thin gages.

*Sales manager, Prodex Corp.

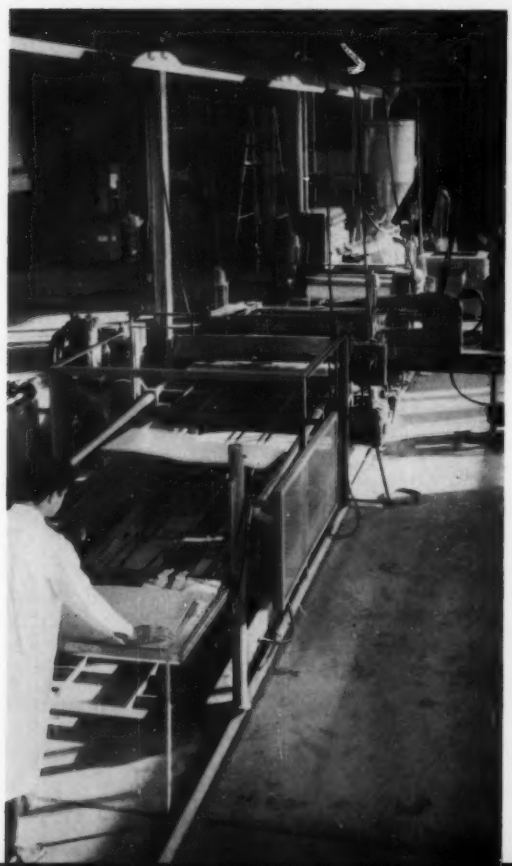
Extruder specifications

Gaylord selected a 3½-in. extruder for this application since a wide variety of relatively short runs is necessitated by the custom sheet extrusion business. The machine has a two-



Adjustment in die opening is made by G. Jansen, production manager, after noting small variation in gage chart. (See next page)

View from take-off end of line, showing location of thickness gage and shear. (Photos, Monsanto Chemical Co.)



stage vented screw with a 24:1 length/diameter ratio, which is further assisted by a hopper dryer in some extreme cases to maintain high production rates. The unit provides superior mixing and dispersion action so that dry-color mixing can be efficiently accomplished. Average output is approximately 350 lb./hr. of sheet over a wide range of thicknesses. A 40 hp. Dynamatic drive with feed-back speed regulation provides a highly stable power source for the extruder so that the screw rotates at uniform speed regardless of conditions. The extruder is provided with a one-piece Xaloy-lined cylinder to obtain the maximum in wear resistance.

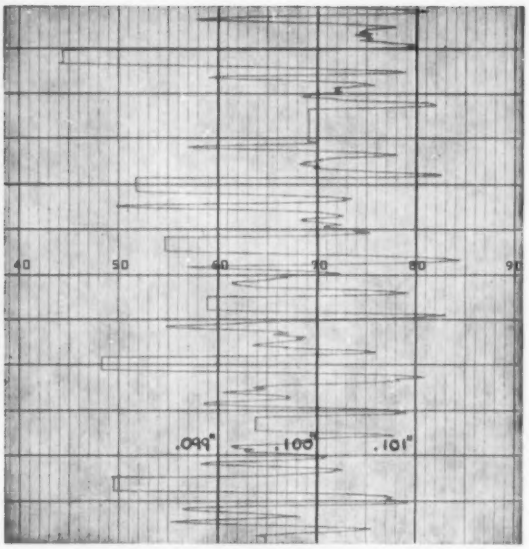
A front cylinder support permits mounting of the heaviest dies without danger of cylinder distortion. The sheeting die is mounted as part of a hinged swing gate for easy removal for cleaning or screen changes. The front of the machine has been tapered to a small cross-section to permit easy access to all die adjusting bolts from one side. Complete pressure and stock temperature instrumentation has been incorporated to facilitate precision operation and trouble shooting. An adjustable valving arrangement at the front of the extruder permits optimum machine regulation for dispersion, uniformity, and output. While the extruder is operated adiabatically under most conditions, a precise temperature control system including fully automatic heating and turbo air cooling provide flexibility of operation over a wide range of products.

Most versatile die

A 50-in. manifold sheeting die with adjustable width permits the production of a range of sheeting widths without loss of efficiency. The unique die incorporates a push-pull adjustable choker bar for uniform flow distribution across the entire die width. The manifold is of a new streamlined design which minimizes material inventory and hang-up and thus facilitates color changes. Losses between succeeding colors are negligible. The lip adjustment is effected by means of a micrometer arrangement which permits positive and precise thickness regulation. Five individual temperature control zones have been provided for flexibility of operation in sheet thicknesses from 0.008 to 0.150 inch.

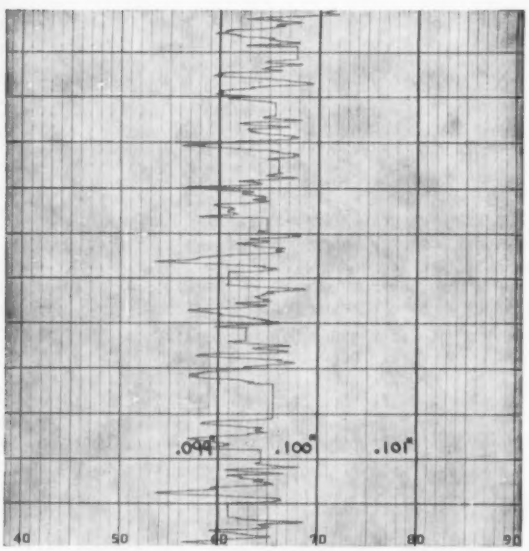
Pressure gages and stock thermocouples at the center and both ends of the die allow an accurate setting of both the die temperature and the choker bar. All controls for both the

Close-up of beta gage. The instrument travels back and forth over full width of sheet without touching it. Measurements appear on recorder in photo below. (Photo, Monsanto)

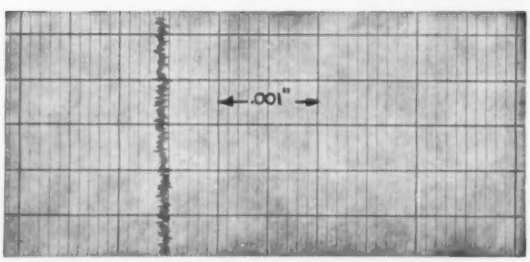


Typical beta gage recording of 0.100-in.-nominal-thickness sheet produced by experienced operator without observing gage. Note that sheet thickness averages about 0.100 in., with a spread of about 0.004 inch. (Charts, Prodex)

Beta gage recorder, like all other controls, is located alongside die to permit observation of sheet thickness while adjustment is being made. Actual charts are shown at right. (Photo, Prodex)



Recording of 0.100-in.-nominal-thickness sheet produced by inexperienced operator with benefit of beta gage. Average thickness is 0.099 in., with about 0.001-in. total spread



Sheet thickness record at one given point of sheet width. Note that precision with valved extruder is about 0.001 inch. With suitable automatic control, precision of this order could be achieved in all directions

extruder and the die are located in a single easily accessible control cabinet. The instrumentation important to the control and supervision of the equipment is grouped close to the forward end of the machine. Among these devices are stock temperature indicators, motor drive tachometer, wattmeter, and extruder speed control. An automatic seven-day time switch in the control cabinet permits preheating of the installation without the services of an operator.

The die power and thermocouple connections are placed on the front plate of the extruder base so that no external conduit and loose wires are present. The die is heated by means of cartridge heaters, which simplifies disassembly for inspection and cleaning, since no wiring need be removed.

Polishing-laminating unit

As the sheet emerges from the die, it passes between a set of polishing rolls. These are pneumatically loaded to provide uniform pressure control. The rolls have a mirror finish for perfect polishing of the extruded sheet. Flatness and concentricity of the rolls are held within better than 0.001 in. to insure uniform sheet gage and finish. They are precisely temperature-controlled by three individual hot-water circulating systems built into the base of the take-off. This arrangement provides a compact and easily accessible system which avoids external piping altogether. The polishing rolls are of a new double shell design which gives optimum temperature control across the entire roll width, together with fast temperature response. Temperatures up to 300° F. are obtainable and can be maintained within close tolerances by thermocouple-actuated controllers.

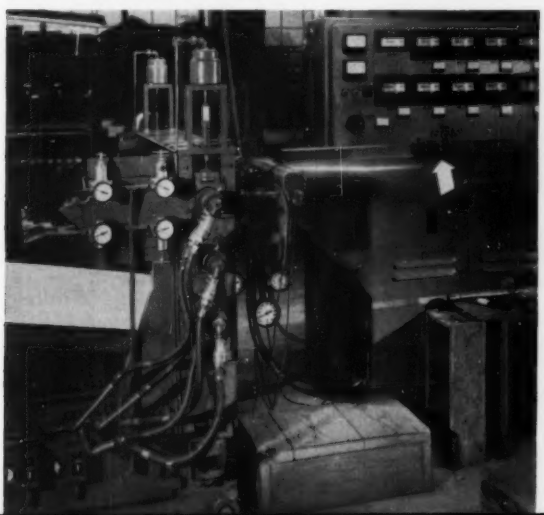
Provision has been made on the polishing stand for lamination on one or both sides of the sheet. Styrene or other films which may be preprinted can be continuously applied to the product as part of the operation. The middle roll of the unit can also be readily changed to an engraved roll for obtaining embossed finishes. The ready combination of all of these effects results in completely new and versatile applications for thermoplastic sheeting.

A roller conveyor supports the sheet beyond the polishing stand so that the product cools slowly and without strains which could seriously impair forming characteristics. The sheet is trimmed or slit into multiple widths by means of a set of shear slitters which precede the pull roll unit.

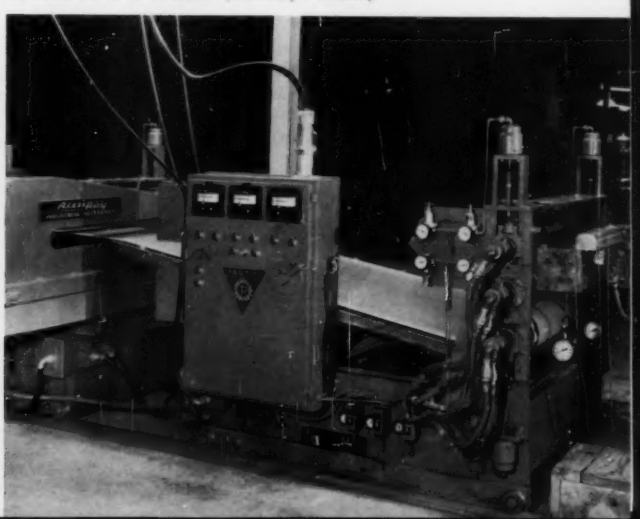
Pull rolls and shear

The sheet is drawn off the polishing stand and over the idler conveyor by means of a set of pneumatically loaded pull rolls. These rolls, covered with a heavy layer of soft rubber to avoid marring the sheet surfaces, feed the sheet to an electrically actuated shear. Sufficient space is provided between the pull rolls and the shear to allow for sheet travel during the cutting cycle. Travelling shears have been dispensed with due to their poor maintenance records and their inability to cut precisely at high linear speeds. The shear is (*To page* 236)

Operating center for extruder and die control. Single control cabinet includes complete controls for motor drive and instrumentation of all variables. Stock temperature indicator and pressure gages permit rapid die control. Note extruder vent (arrow) for moisture removal

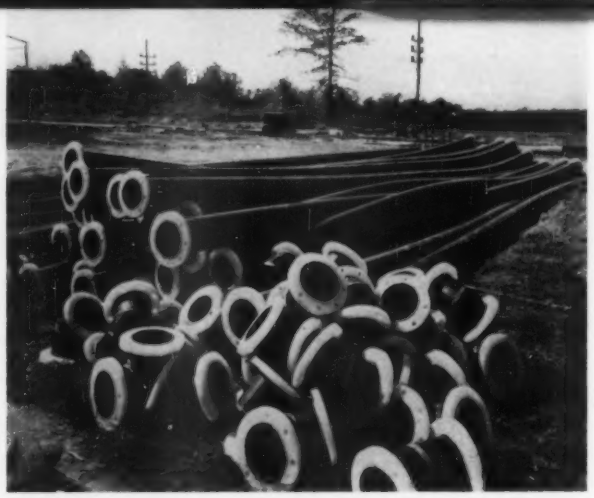


Polishing and gaging units are adjacent to die. Polishing unit incorporates three separate roll temperature control systems. All take-off controls are located in a central panel with single power plug-in. Beta gage is mounted on take-off to measure sheet as soon as it is cooled. (Photos, Prodex)



Section of polyethylene pipe, 30 ft. long, is taken off conveyor as it leaves extruder at Carlon Products' Asheville, N. C. plant

Flanges, also produced from polyethylene, are hot-gas-welded to extruded pipe sections



Stockpile of straight pipe sections and elbows, with flanges welded on, ready for installation at the Ashtabula site

BIG polyethylene pipe

Coupled with welded and bolted flanges, 7-in. pipeline more than a mile long carries saturated brine solution

In one of the longest installations of polyethylene pipe on record, 6200 ft. of 6-in. plastic tubing now links two important plants in the Ashtabula, Ohio, chemical complex.

The pipeline was installed to carry saturated brine (pH <7) from the zirconium and titanium sponge plant of Mallory-Sharon Metals Corp. to the sodium plant of U. S. Industrial Chemicals Co. U.S.I.'s Petrothene resin, compounded with carbon black, was used.

All of the extrusion of the pipe was done by Carlon Products, Inc., Cleveland, Ohio. Supplied in 30-ft. lengths, the pipeline sections weighed 120 lb. each. I.D. of the pipe is 6.07 in., O.D. 7.26 inches.

After a careful evaluation of different possible materials for the pipeline, polyethylene got the bid because it is highly impervious to brine solution and offers the advantage of minimum maintenance. The pipeline is in continuous, round-the-clock use.

Back-up rings of steel are attached to flanges where elbow meets straight section

At installation site, workers connect lengths of pipeline by bolting sections together

Over and in goes the pipeline. Unlike steel pipe, which requires a great deal of final adjusting in the trench, this whole section of polyethylene pipe was simply rolled into place with a single push and needed no further attention. (Photos, U. S. I.)

Film disposables

Disposable mittens, gloves, and tray covers, fabricated from polyethylene film, reduce clean-up chores after roller painting, car washing, gardening, and eating fried chicken. The flexible one-finger gloves, secured by rubber bands at the wrist, keep hands free of paint, soil, and dirt. The tray cover, made with a pouch at either end to hold it in place, serves as a temporary lining for pans used in roller painting. The mitts, used for eating fried chicken, have a separate compartment for the thumb and extend well over the wrists. They act as a moisture barrier, keeping hands free of grease but permitting ample movement of fingers for gripping and holding. All three products have shown success as give-away premiums.

Credits: Tenite polyethylene by Eastman Chemical Products, Inc., New York, N.Y.; extruded by Flex-O-Glass, Inc., 1100 N. Cicero Ave., Chicago 51, Ill.; fabricated by Vonco Products, Inc., 151 Hawley St., Grayslake, Ill.

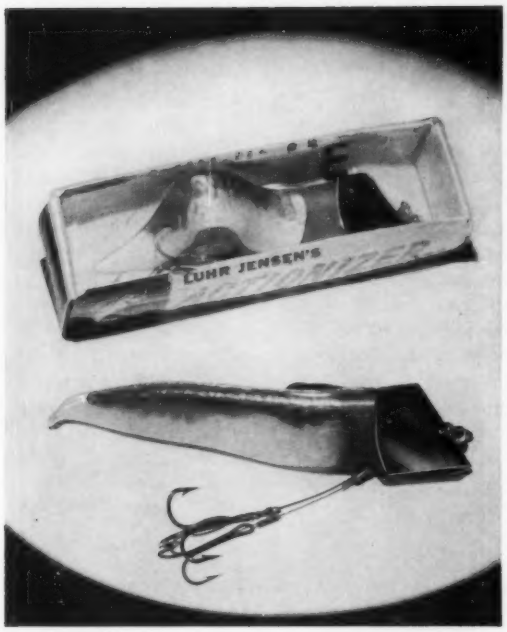
PLASTICS

Baby bottles that

The plastics industry has finally come up with a product that's been needed as long as there have been babies—a low-cost, unbreakable nursing bottle that can be steam sterilized. With bottles of high-density polyethylene now a commercial reality, a mother need never again be confronted with the prospect of a baby bottle being "sterilized" down to a shapeless glob.

The new polyethylene bottles can be used without fear of collapse in any home sterilizing unit—to 250° F.—as well as simply boiled in a pan. Under test, the bottles withstood months of repeated hospital sterilization without distortion.

The Feed-Rite Nurser, as the new bottle is called, is blow molded of linear polyethylene in two sizes—4 and 8 ounces. It is calibrated in both ounces and cubic centimeters. Along with each bottle, the manufacturer supplies a screw-on collar to hold the rubber nipple, and a slip-on cover to protect the nipple and keep it clean. Both the



Plastisol lure

A plastisol fishing lure resembling a cut herring has been designed for fishermen in pursuit of salmon or other large fish. The new lure is authentic in detail, has exceptionally bright colors and excellent durability.

The lure is made of vinyl dispersion resin cast in open molds. Appropriate amounts of plasticizer and pearlescent pigment provide a soft fish-like texture and a shimmering fish-scale effect. The plastisol formulation provides the fluidity necessary for good mold reproduction, permits full color development, and imparts flex life as well as abrasion and water resistance. In action, the lure makes wide sweeps underwater when the hook is permitted to trail free, whereas the more natural movement of a swimming fish is obtained by inserting the hook into the plastic.

Credits: Molded by Luhr Jensen & Sons, Hood River, Oregon, from Pliovic AO resin supplied by Goodyear Tire & Rubber Co.'s Chemical Div.

PRODUCTS

can be boiled

collar and the nipple cover are also molded of high-density polyethylene, and can be sterilized along with the bottle. The collar can be adjusted by twisting to speed up or slow down the flow of formula to the baby. The 8-oz. bottle size is also manufactured in a nipple-inversion model, on which a removable seal replaces the protective nipple cover.

The new baby bottle is considerably lighter than bottles of conventional polyethylene. The 8-oz. size weighs 25 g., compared to 40 g. for a typical low-density polyethylene bottle, and about 200 g. (about ½ lb.) for a glass bottle.

Credits: Bottles manufactured by Plax Corp., Hartford, Conn. Nipple collar and protective cover for nipple molded by Cowan Boyden Corp., Providence, R.I. All three parts use Marlex 50 polyethylene supplied by Phillips Chemical Co., Bartlesville, Okla. Product marketed by Davol Rubber Co., Providence, R.I.

Molded leaf rake

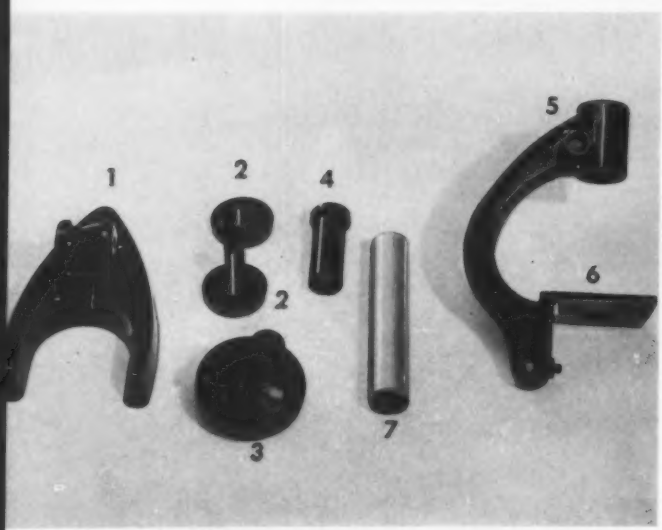
One of the first products using low-pressure-processed polyethylene to be made commercially available is a new molded leaf rake designed to take advantage of the increased stiffness of the high-density material. The rake is stiff enough to withstand pulling over rough ground contours, yet retains enough flexibility to permit use of a light sweeping rather than a heavy scraping action in collecting fallen leaves. The prongs of the new rake will remain flexible even at temperatures below zero. There is almost no danger that the prongs will break off, even with the hard treatment to which garden tools are usually subjected in use and storage.

The rake is molded by the manufacturer in the same mold formerly used for a similar butyrate model. Retail price is $1.

Credits: Molded by The Campro Co., Canton, Ohio, from Super Dylan linear polyethylene supplied by Koppers Co., Inc.

PLASTICS

Operating microscope molded of



Made up primarily of molded high-impact styrene parts, the "Invisible World" toy microscope gives the budding (8 to 12 year old) scientist his first magnified look at nature without leaving a major dent in his parents' pocketbook.

Marketed in kit form to retail at $4.95, the microscope is, however, more than just a toy. It is an operating, low-power, large-field-of-vision instrument—complete with precision ground lenses —that also has a high educational value. Pre-enlarged slides, optionally available from the manufacturer, in combination with the microscope, permit magnifications up to 30,000X.

The molded styrene parts, as identified in the photo at left, are: 1) base; 2) focus adjusting knobs; 3) three-magnification turret (optional; standard kit contains instead a single-magnification objective lens holder); 4) eye piece; 5) frame; and 6) platform. The focusing tube 7), made of aluminum in the model shown in the photograph,

Marine battery box

A new portable reinforced plastics "ship-to-shore" battery box is now available to boat owners for use in transporting batteries easily and with a minimum of handling. Because of its high impact strength, as well as its resistance to corrosion, chipping, and denting, the box serves as effective protection for the batteries while they are being transported.

The turquoise-colored lid of the battery box is molded of a polyester resin-sisal fiber compound. The white main housing of the box is molded of polyester resin reinforced with fibrous glass mat. Matched metal molding is used in both cases. The battery box is held together with a strong fiber strap that also serves as a handle. The 9½- by 12- by 10½-in. dimensions accommodate most batteries used in marine service.

Credits: Manufactured by Firmaline Products, Inc., Midland Park, N. J., from Laminac polyester resin supplied by American Cyanamid Co.

PRODUCTS

impact styrene

is currently being extruded of rugged Cycolac styrene terpolymer.

The parts are molded in a family mold at a rate of 90 shots per hour, 4 oz. per shot. The platform is molded integrally with the frame, and two molded-in holes accommodate metal clips that hold specimen slides in position. A third hole permits passage of light reflected from a metallized acetate mirror lens. Focusing tube collar and focusing knob bushings are also molded in. Close-tolerance design makes assembly easy and assures reliable operation of all of the microscope's moving parts.

According to the manufacturer, "high-impact styrene was chosen because of weight, durability, elimination of painting and finishing operations, and eye appeal."

Credits: Molded by Armor Plastic Molders, Culver City, Calif., for Interstate Adjusteze Corp., Anaheim, Calif.; styrene by Dow, Cycolac by Marbon.

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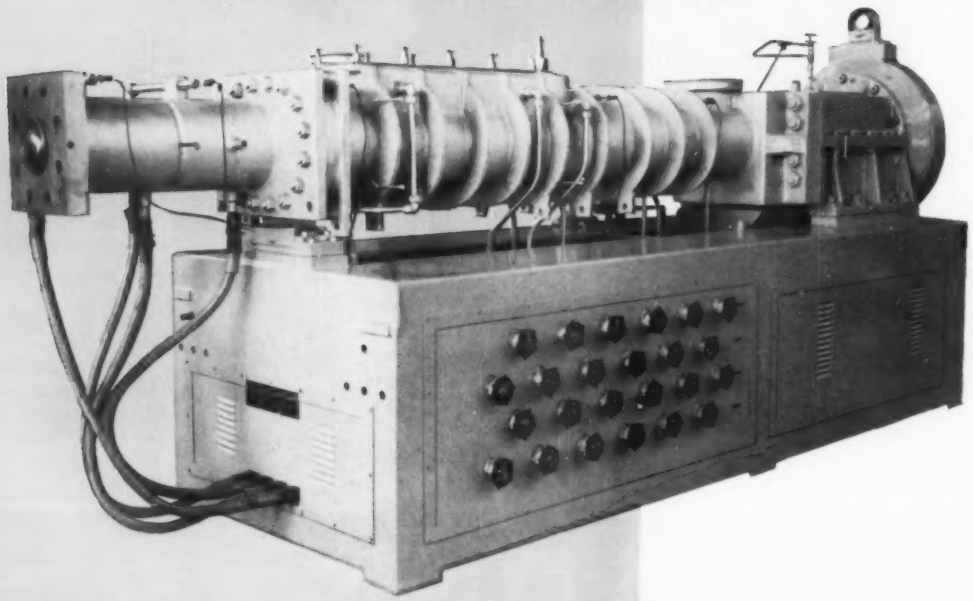

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Plastics Engineering

Dr. James F. Carley, Engineering Editor

Factors affecting the Heat sealing of polyethylene film

By R. M. Knight† and W. U. Funk‡

A satisfactory heat seal may be defined as one that is at least as strong as the film it joins. Other factors being fixed, there is a range of sealing times that will yield satisfactory seals at a given sealer temperature. Both the mean sealing time and the operating range decrease as temperature rises, so that top productivity requires closest attention to process control. At a given temperature, the required clamping time decreases as sealing pressure or resin melt index increase, or as density or film thickness decrease. Increasing pressure or density also narrows the operating range. Over the practical concentration range, slip additive has no significant effect on the operating region boundaries. Sealing gusseted film requires close attention to conditions if good seals are to be made; some lengthening of cycle time (over that required to accommodate the extra thicknesses) is advisable in the interests of control of seal quality.

A number of film fabricators have had difficulty achieving strong heat seals with polyethylene films. It was suspected that this difficulty had several sources —differences in resins, film thickness, additives, surface treatment, and operating technique were all possible candidates. The object of the study reported here was to determine the nature and magnitude of various film and operating variables on the strength of heat-sealed joints in polyethylene films. The effects of film-making and flame-treatment on sealability were recently reported (1, 2)[1] and are not discussed here.[2]

Apparatus and procedure

The sealer used in this work is a Sentinel Model 12 ASC,[3] jaw-type sealer in which the heat is supplied by contact with a hot, double bar from one side only. The films to be sealed rest on an unheated silicone rubber pad and are covered by a thin membrane of TFE-resin-coated glass cloth. The hot bar presses down on the glass cloth with a predetermined pressure ranging, in this work, between 40 and 240 p.s.i. of seal area. The compressibility of the rubber pad insures uniformity of pressure over the entire seal area, which consists of two strips each 12 in. by ⅛ in., spaced ½ in. apart. A schematic drawing of the sealer is shown in Fig. 1, p. 134. A timer with a range of 5 sec., adjustable in 0.1-sec. increments, controls the time of application of the pressure to the film. Intermediate time settings could be estimated; and some measurements were made even at clamping times of 0.05 sec. (±0.01 sec.)

In polyethylene films, a good seal can support a heavier load than the film because of its greater thickness. Such a seal will resist tearing under a load sufficient to tear the film. If sealing time is too short or temperature is too low to accomplish a thorough weld, the seal will be weaker than the film. Similarly, if pressure, time, or temperature is too high, the film may be oversoftened so that it flows out of

*Reg. U.S. Pat. Off.

†Production Manager, U.S. Industrial Chemicals Co., New York 16, N.Y.
‡Research and Development Dept., National Petro-Chemicals Corp., Tuscola, Ill.

[1]Numbers in parentheses link to references at the end of article, p. 251.

[2]The principal finding of these reports was that unless flame intensity, film speed, and the distance between flame and film are carefully controlled, sealability of the film will suffer; but if these factors are controlled to avoid overtreatment, sealability is equal to that of the untreated resin. Effects of crystallinity and orientation of film on sealability were also investigated.

[3]Packaging Industries, 151 Pine St., Montclair, N.J.

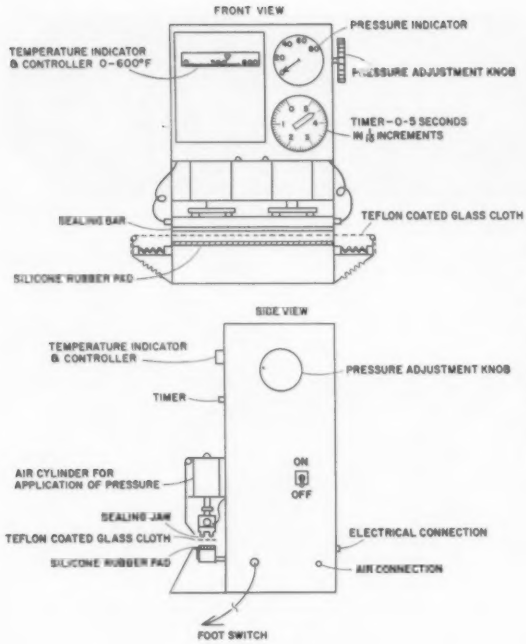

Fig. 1: Diagrammatic sketch of heat-sealing equipment used in work reported here. Double-footed sealing jaw is resistance-heated, makes two parallel 1/8- by 12-in. seals simultaneously

the edges of the seal and the seal actually becomes thinner, therefore weaker, than the film. From the practical standpoint the seal ought to be at least as strong as the film; that is, it should withstand a load under which the film fails. This was the criterion used in this work to determine the region of satisfactory sealing.

The experimental procedure consisted of selecting a film of a given thickness made of a given resin, setting the sealing pressure to 40 p.s.i. and the time to, say, 3 seconds. A series of seals was made over a range of temperatures at 5° F. increments, and, after cooling, each was tested for strength. This established the range of sealing times over which satisfactory seals can be made at 40 p.s.i. and 250° F. with the given film. The temperature was then adjusted to a new level and more seals made over a range of times. This was repeated at a number of temperatures with results that were plotted as in Fig. 2, below. The broken lines represent the limits of the satisfactory sealing region of time and temperature, while the solid line, which has been drawn midway between the limits, represents the locus of safest operating points in the region. The graph, though plotted as time vs. temperature, can be looked at either way; i.e., the vertical gap between the broken lines represents the safe time range at a given temperature while the horizontal range represents the safe temperature range for a given sealing time. Note that the time scale is logarithmic and that the allowable time range, while it appears constant on this scale, is actually proportional to the median time, and decreases at the higher temperatures. For example, at 300° F., the optimum sealing time is about 1.1 sec. for the resin, thickness, and pressure of Fig. 2, and the safe range is about $2.2 - 0.5 = 1.7$ seconds. At 500° F., on the other hand, the safe range is only $0.40 - 0.13 = 0.27$ seconds! Thus the operator must be much more careful in his control of the sealing time when

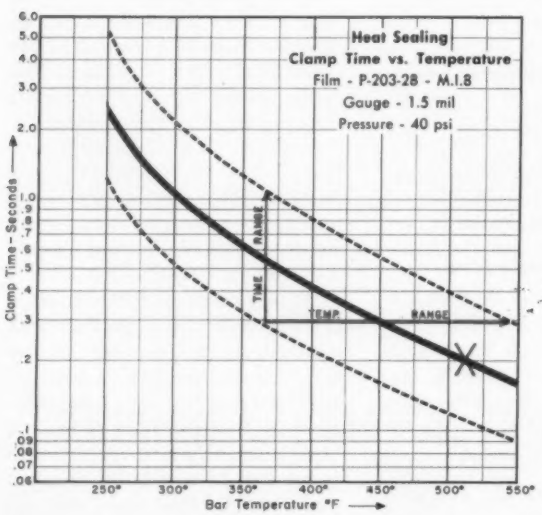

Fig. 2: Typical operating "map" for hot-bar sealing of polyethylene film. Broken lines enclose operating range within which satisfactory seals can be made

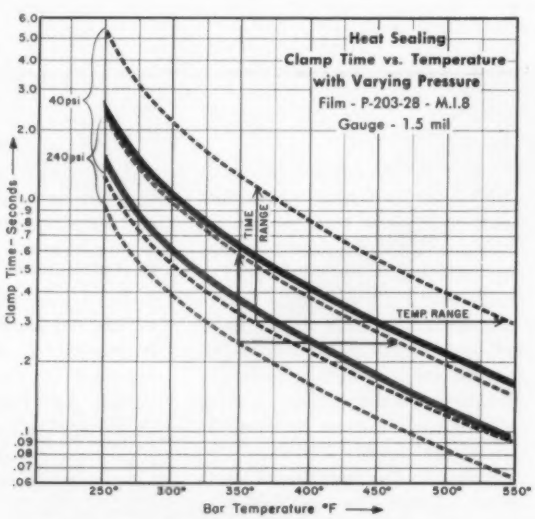

Fig. 3: Time-temperature maps at two different sealing pressures for same film as in Fig. 2. Raising pressure shortens cycle but pinches operating range.

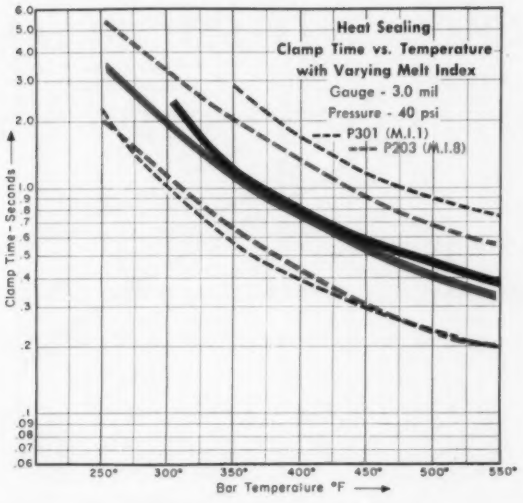

Fig. 4: An eight-fold change in melt index has only a slight effect on satisfactory sealing region; low-flow resin requires slightly longer sealing time, but offers wider latitude

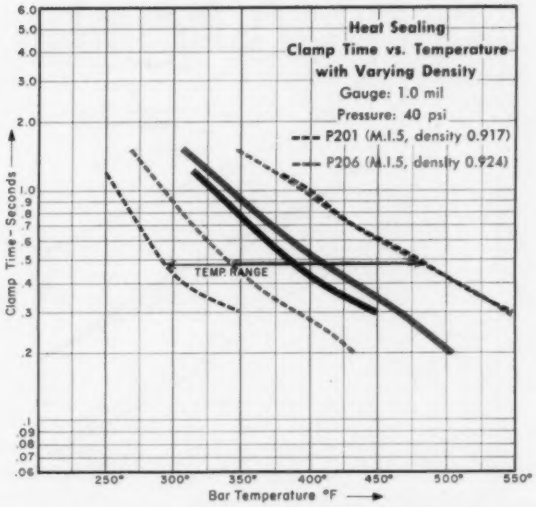

Fig. 5: Resin structure, as indicated by density, has definite effect on sealing region. Higher-density resin needs higher sealing temperature, has narrower operating range

sealing at high temperatures than at low temperatures. Note also that, since the temperature scale is linear, the temperature tolerance at a given sealing time does not vary much over the entire operating temperature range.

In spite of the tougher time-control problem, there are two good reasons why the operator should seal at high temperatures: 1) his cycle time is shortest and his productivity (where sealing time is a major part of the fabricating cycle) is greatest; 2) the operation is less likely to be upset by heat build-up. As the machine is sealing, heat tends to accumulate in the unheated silicone pad. The accumulation becomes more serious as the clamping time becomes a larger part of the total cycle, and can result in a temperature rise of as much as 50° F. This narrows the working temperature range. Operating at a point such as *X* on the graph, the fabricator will get the least build-up and the widest effective temperature range.

Experimental results

Figure 3, p. 134, shows that increasing the pressure reduces the sealing time required at a given temperature, or, conversely, for a given clamping cycle, a higher clamping pressure requires a lower operating temperature. However, raising the pressure also narrows the operating ranges of time and temperature, so that the fabricator has less flexibility of operation at higher pressure, even though there is a reduction of sealing time.

Rather large changes in melt index (MI) have very little effect on the time-temperature region of satisfactory sealing, as Fig. 4, above, shows. Since the melt index is a measure of the flowability of the resin, it might reasonably be expected that a high-MI resin will seal a little faster than a low-MI resin, and the small difference indicated in Fig. 4 is probably real. The softer resin has a narrower operating range than the low-MI material, however. Other results indicate that the difference in the operating ranges is more pronounced with thinner films. It is interesting to note that the lower-limit curve is about the same for all melt indexes—the spread occurs at the upper limit of the operating range.

In polyethylenes, increasing density is usually associated with greater linearity of molecular structure, and greater crystallinity in the solid phase. These structural characteristics are reflected in the higher and sharper melting points of the denser polymers. One would expect, therefore, that sealing temperatures will be higher for denser polyethylenes and the operating ranges should be narrower. While the range of density explored in this work is small—from 0.917 to 0.924—comparison of the time/temperature regions of satisfactory sealing for these two resins bears out the theoretical conclusions. The curves are shown in Fig. 5, above. Note that the less dense resin becomes sealable at temperatures 35 to 50° F. lower than does the more dense resin, even though they have equal melt indexes.

It was felt before the study was begun that slip additives might affect sealability adversely. One of these additives was investigated at several concentration levels with results typified by Fig. 6, p. 136. Although one set of tests on film containing the highest concentration of slip compound indicated some narrowing of the operating range at the short-time end, the rest of the data, from at least six other sets of tests, indicate that, over the practical range, the slip additive had no significant effect on either the upper or lower operating-limit curve.

Film thickness, of course, is an important factor in determining operating conditions. With a

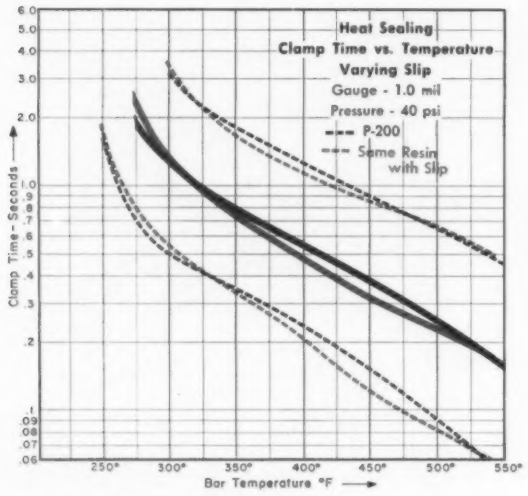

Fig. 6: Addition of slip agent leaves sealing characteristics of polyethylene film unaffected over practical range of additive content

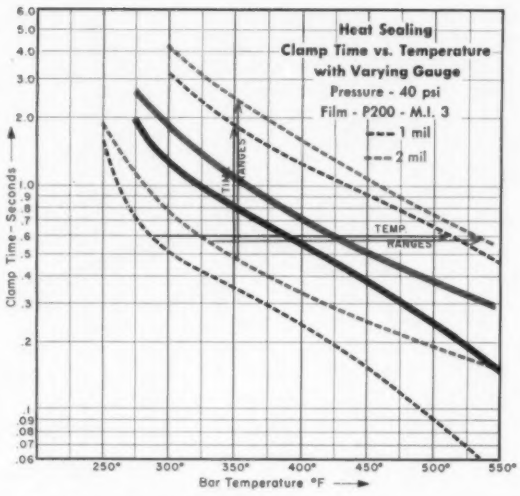

Fig. 7: Sealing time at a given temperature increases sharply with increasing film thickness. Range is unaffected

given resin, the lower operating curve represents the time required to achieve a true molten state at the film interface. This in turn is merely a matter of reaching the proper temperature at that interface. Since we are dealing here with heated areas whose length and width are considerably greater than their thickness, the usual equations for transient heat conduction through large slabs should hold, at least approximately. It is to be expected, therefore, that if the heating bar were in direct contact with the film, the time required to reach the molten state would be proportional to the square of the film thickness. However, the TFE-coated glass cloth separates the bar from the film, and it, too, must be heated each time, though not quite as much as the cold film. If the coated cloth membrane is considered equivalent to about 3.5 mils of polyethylene film, the theoretical relationship holds quite nicely. Thus we should expect that if the lower-limit time at a given temperature is 1 sec., say, for a 1-mil film, then a 2-mil film of the same material will require $1 \times (2 + 3.5)^2/(1 + 3.5)^2 = 1.5$ seconds. A 3-mil film would require 2.1 sec., and so on. Of course, these figures hold only for this particular TFE-

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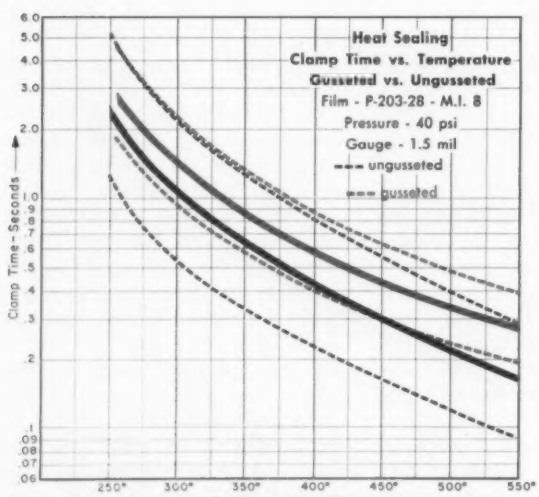


Fig. 8: Gusseted film is more difficult to seal than unpleated film of same thickness and requires expected longer time

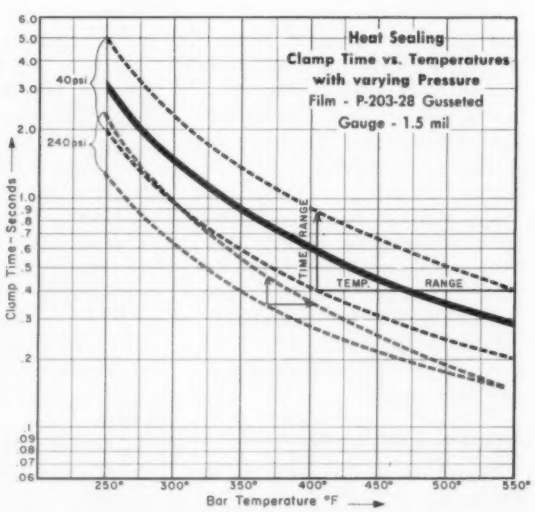


Fig. 9: Sealing of gusseted film at higher pressure, though faster, requires painfully close control of time at high temperature and good control of temperature on almost any cycle. For best control of quality, gusseted films should be sealed at low pressures and slow cycles

Automatic blow-loading of inserts

Newly developed technique brings major economies to molding where insert loading time takes a large part of cycle, can also speed many assembly operations

On many high-production molding jobs involving large numbers of inserts, the efficient handling of such inserts may spell the difference between profit and loss. With the growing trend to complex electrical and electronic assemblies incorporating standoff terminals, multiple connectors, printed circuitry, and related components, automation of insert loading for molding and of parts loading for assembly has become increasingly necessary.

High-speed, automatic loading of inserts for molded plastic parts has now been achieved at the plant of Whitso, Inc., Schiller Park, Ill., a custom molding firm specializing in the production of electrical and electronic components. This operation is handled on a new type of equipment called a Freeloader,[1] which was originally developed by Whitso for its use in loading various inserts used in molding small standoff terminals, but is now also available to other molders.

How it works

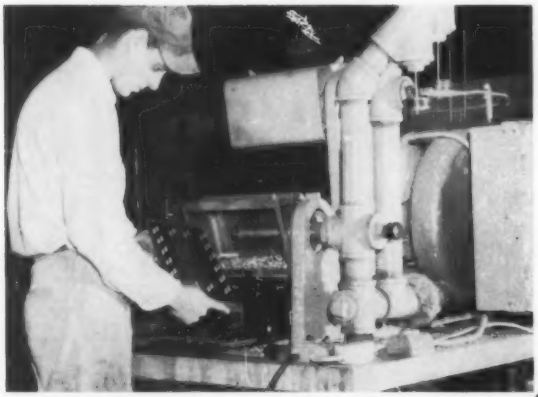
Combining pneumatic and mechanical action, the machine operates on a "blow-loading" principle. Essentially, its function is to position and orient small parts in a predetermined pattern for batch handling in any manufacturing operation, whether it be plastics molding or assembly of finished parts. A typical non-molding application involves the automatic positioning of small molded nylon rivets for a punch-press operation.

Metal inserts or other parts to be loaded are dumped into an oscillating drum having a chrome-plated interior surface and a transparent glass end. Also secured to the face of the drum by means of spring-loaded metal bars is a perforated collector plate into which the parts are to be deposited. Air pressure, supplied by a centrifugal blower, is introduced into the chain-driven drum, which oscillates 12 times per minute through a 270° arc. Air turbulence within the drum takes the form of a vortex, spiraling out through the openings in the collector plate. Passing over these orifices as the drum oscillates, the parts are automatically drawn into them by the air movement. When an insert cannot lodge in an orifice because it is trying to enter in incorrect position, it is temporarily swept aside

Over-all view of Freeloader, showing nylon rivets automatically positioned by blow-loading for punch press operation

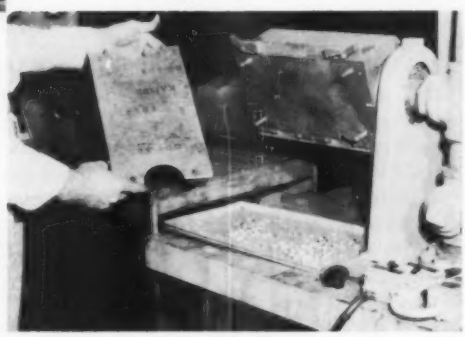
[1]The Freeloader is the subject of U.S. Patent application and is being produced by Whitso.

Loading inserts for molded phenolic switch bases



Transfer molding of phenolic switch bases for automotive window lift begins with automatic blow-loading of metal inserts. Each switch base contains two inserts and parts are produced in 16-cavity mold. Above, operator has removed collector plate from drum of blow-loading unit mounted beside press. Plate has opening for 64 inserts arranged in offset pattern. Resting on table in foreground is insert loading tray for placing inserts in mold

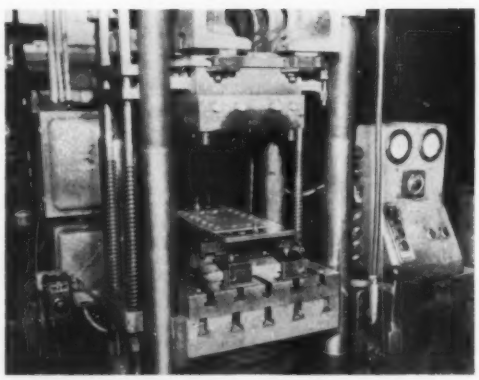
Transfer plate used to reverse parts before they are placed in insert loading fixture. Collector plate has been replaced in oscillating drum for next loading cycle. (Illustrations, Whitso, Inc.)



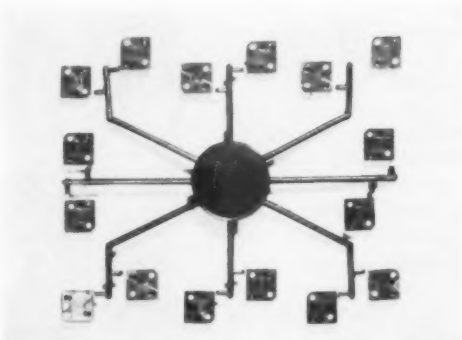
by the tumbling mass of other parts. However, as soon as it enters an opening in correct position, it seals the orifice and will remain seated until the air pressure is released. The device is so sensitive that it can discriminate between ends of inserts having a diameter differential as small as 6 to 8 mils.

Drums are provided with a removable center divider so that different types of inserts can be handled simultaneously in the same drum. When the divider is in position, differential air pressures can be maintained between the near and far side of the drum. This is done by placing an adjustable C-ring behind the spring in the near half of the tank. When equal pressure is desired in both sections, the C-ring can be placed ahead of the spring, making it inoperative. Air pressures within the drum usually range from 4 to 22 in. of water. Since adequate *volume* of air is basic to operation of the machine, a centrifugal blower rather than an air compressor is part of its design.

Within the range of design and size variations tested to date, the size of insert handled appears to have little effect on the operation of the blow-loading device. A 1-in. No. 10 screw will load as easily in the machine as a sub-minia-



Loading board on lower half of mold mounted in 150-ton press. Slides in board allow independent release of either pattern



Close-up of complete shot from 16-cavity mold for switch bases. Each of the finished parts incorporates two molded-in contacts

ture electronic terminal. It is also possible in some cases to combine different sizes and types of inserts in the drum for selective sorting into the collector plate. Various parts tested have been loaded in from 30 sec. to 3 minutes. The design of the collector plate and the amount of air pressure in the drum also affect the loading time.

The blow-loading machine is available in single-drum, double-drum-common-drive, and double-drum-individual-drive models. It comes equipped with fully enclosed motors which power the drum and blower. The only installation necessary consists of connecting the unit to a 220/440-v., 3 phase, 60-cycle current. A push-button control panel contains provision for turning the blower on and off and starting, stopping, and "parking" the drum. Air from the blower enters the drum through a replaceable filter which is changed as often as necessary to keep it from blocking the flow of air. A bypass valve permits adjustment of air pressure within the drum. Weights added to the valve stem provide self-correcting pressure control.

Economics

While the blow-loading machine could be used on any job involving small inserts, it offers the greatest savings on jobs involving many and/or very tiny inserts. When inserts must be hand-loaded with tweezers, the loading time may be the major portion of the cycle. Even with the simpler jobs, the blow-loader can increase the operator's productivity, giving him more time for deflashing parts, inspecting parts, placing cured moldings in shrink fixtures, etc. Because each job is, to some extent, unique, it is impossible to state categorically how many inserts or what size must be involved in a molding job to justify the use of the blow-loading machine. Economical operations to date have included as few as 30 inserts per cycle. Factors such as number of inserts per part, location and type of inserts, number of cavities in the mold, and total production requirements all enter into the economic picture. A molder equipped with a blow-loader certainly has greater latitude of tooling when setting up for a given job. For instance, on a job where even a single-cavity operation would entail insert-loading problems, using the blow-loader might permit the use of more cavities.

The important thing is that the time normally taken by the press operator to place inserts in the mold or into a loading fixture is virtually eliminated. Also, the quick changeover from one col-

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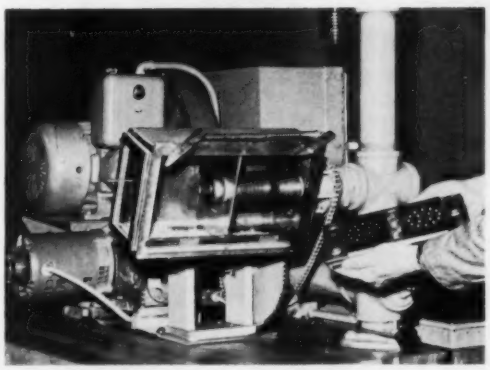
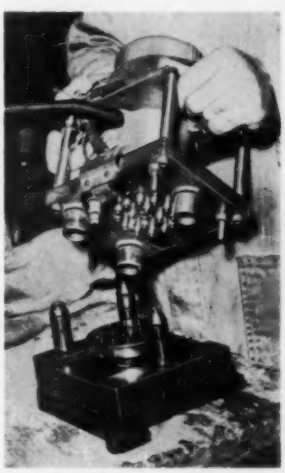
Blow-loading inserts for melamine standoff terminals

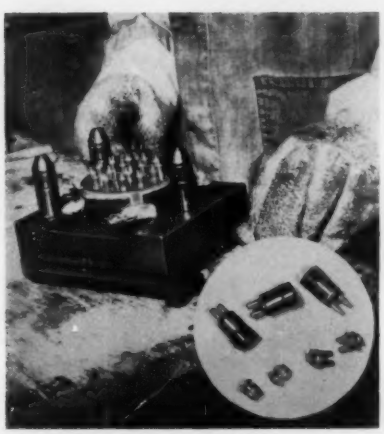


Double-pattern collector plate for automatic blow-loading of inserts used in molding standoff terminals in a 16-cavity mold

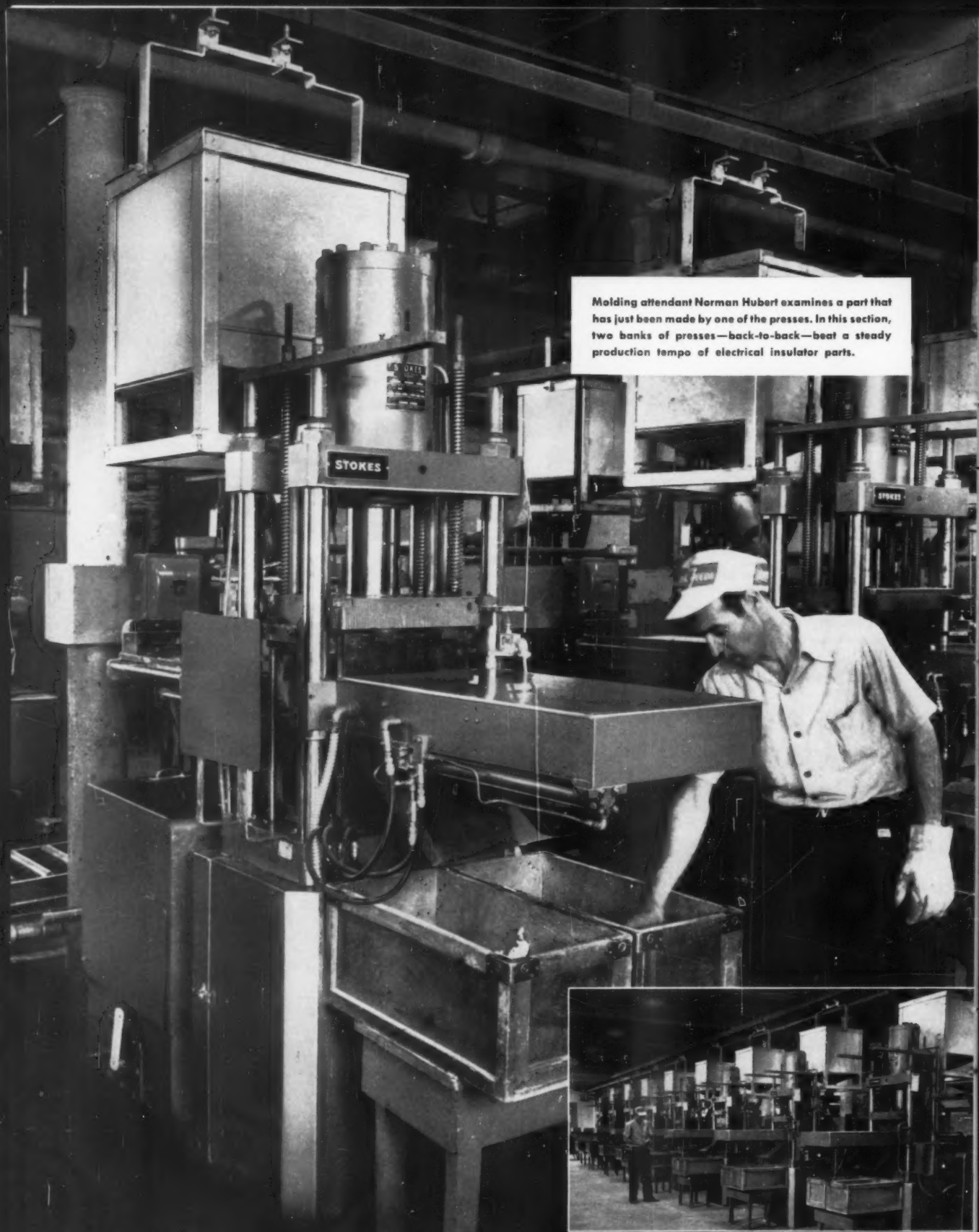
Blow-loaded inserts positioned on transfer plate, which was placed on top of collector plate so both could be inverted together. This technique leaves inserts in proper location on the transfer plate



Sixteen inserts about to be loaded in top half of mold, which has been removed from press. Electrically powered fixture automatically screws inserts into position on mounting studs. Loading of bottom half of mold proceeds in a similar manner



Finished molded standoff terminals, ready to be unscrewed from mold by power fixture. Insert shows typical finished parts



Molding attendant Norman Hubert examines a part that has just been made by one of the presses. In this section, two banks of presses—back-to-back—beat a steady production tempo of electrical insulator parts.

Bryant Electric's Plastics Department buys additional Stokes Model 741's for high-speed automatic molding

Fully automatic compression molding, on Stokes Model 741 presses, produces a wide variety of insulating parts for appliances, wiring devices and switch gear for this Connecticut manufacturer.

The Bryant Electric Company, Plastics Department, a subsidiary of Westinghouse Electric Corp., is thoroughly convinced of the excellence of Stokes automatic molding equipment. Twenty Model 741 50-ton presses have been in constant use, with another six just installed. Molded insulating parts for electrical appliances, lighting fixtures, switch gear, wiring devices, and the like, are being produced at high rates of speed—with dependable precision.

The fully automatic operation of the 741's requires minimum monitoring—there is not much that the attendant does other than remove the bins when they are full, occasionally check on parts as they are dumped into the bins, and load the hoppers with the molding compound.

The Plastics Department of Bryant selected Stokes equipment for its high standards of workmanship and excellence of service. Fully automatic production of these parts resulted in lower manufacturing costs and enabled them to meet competition more favorably.

For your own molding operations, it will pay you to check the advanced features of the new Stokes 741's that bring you fully automatic compression molding in its most fool-proof, most productive form.

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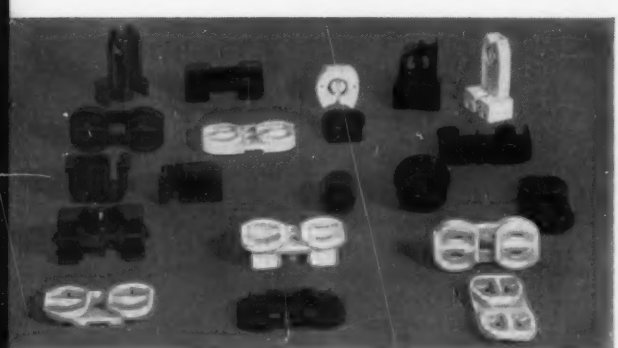
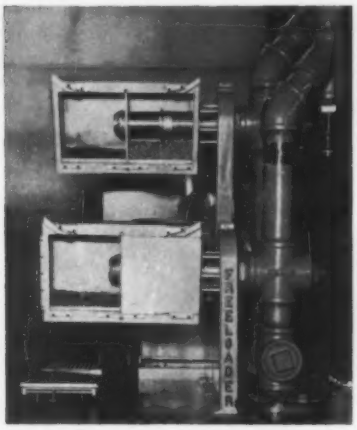


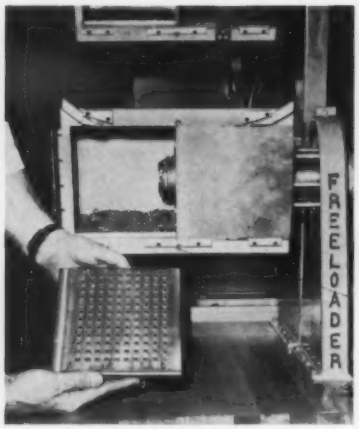
Above are some of the many parts produced at the Plastics Department of Bryant Electric including duplex outlets, switch blocks, and fluorescent lamp holders. At left, a partial view of the bank of Stokes 741 presses installed at Bryant Electric's Plastics Department.

STOKES

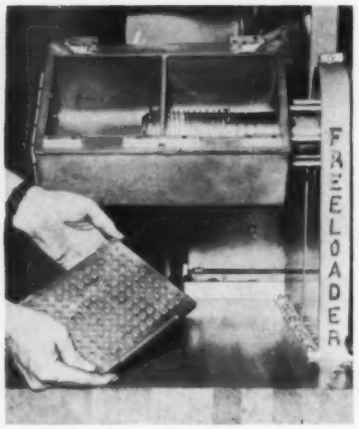
Blow-loading parts for an assembly operation



Metal rings, electrodes, and glass beads are separately stored in three compartments of the Freeloader



Rings have been loaded in collector plate which will next be placed on compartment containing the beads, and process repeated on chamber holding electrodes



Loading of full assemblies is now complete. Next they are inverted and transferred to carbon chuck in which they are held during oven fusing

lector plate to another permits immediate shifting to different jobs. Depending upon the type of parts being molded and the production requirements, one machine might serve two or more presses simultaneously.

In production tests, Whitso studied the use of the machine on a molding operation in which standoff terminals for electronic use were transfer molded. As part of his procedure, the press operator formerly hand-loaded a 20-cavity mold with two inserts per cavity. The terminals were small enough to require handling with tweezers. When the blow-loading equipment replaced manual loading, production doubled. Analyzed on the basis of a 7½-hour shift, it was found that in one shift's work the operator could machine-load 10,000 blow-loaded inserts. Cumulative insert handling time amounted to about 2 hr., whereas 9½ man-hours were previously required to handle the same quantity of inserts. Estimated savings per year on this operation, as reflected in more productive use of labor and increased parts output, were approximately $13,000.

Operation

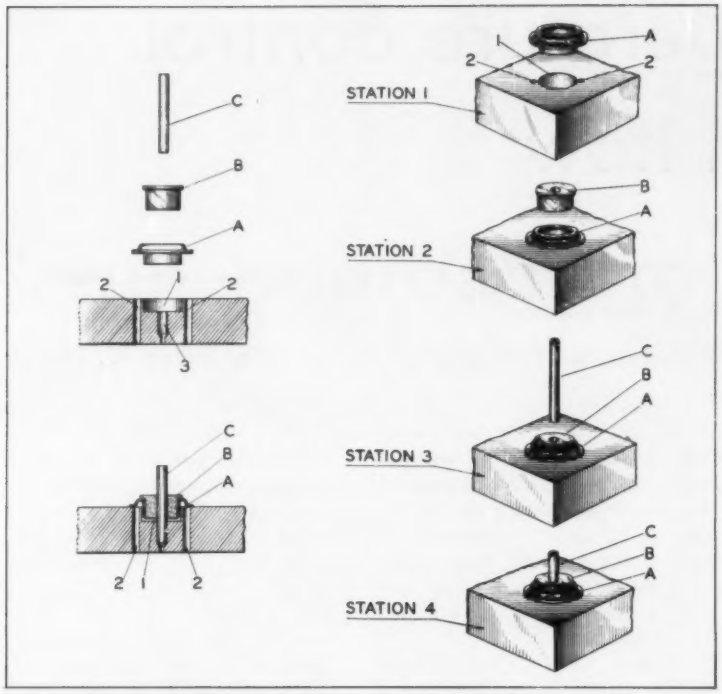
Operation of the blow-loading equipment is illustrated by a typical molding job run by Whitso. The part involved is a tiny gold-plated electronic terminal, 20 of which are molded as inserts in a melamine insulating base. The metal inserts are dumped into the drum and the collector plate snapped into position. Openings in the plate coincide with those in a suitable fixture used to transfer the inserts into the mold. The plate is made with two identical patterns which load simultaneously. At the end of the loading cycle, the drum is parked, the air shut off and the collector plate removed from the drum with all the terminals uniformly positioned in the required loading patterns. Next, the inserts are transferred from the collector plate to the mold by means of a pickup fixture which contains individual sleeve collets for each terminal. The fixture is placed over the collector plate, picking up the parts, and they are then released into the mold cavities. Molding proceeds in the normal manner.

When handling inserts which because of their design must be loaded in reverse position in the collector plate, an intermediate transfer plate is used to invert them so they can be placed in the mold in proper position. Once inverted, they are then handled in the usual manner by the pickup fixture. Other means of transferring the prepositioned parts into the mold can also be used when necessary.

The collector plates used for any given insert job are steel plates about 5/16 in. thick, drilled or slotted so that parts can enter them only in the correct position.

They can be supplied by the equipment manufacturer but are usually made up by the molder's own tool department. A standard plate has a working area approximately 6.8 by 12.2 in. in size. Plates can be made up quickly at a cost ranging from about $50 to a few hundred dollars. One blank set of plates is furnished with each blow-loading machine.

Another interesting standoff terminal job involves the use of loose melamine powder and a hand mold. On each cycle, the top half of the mold is removed from the compression press so the blow-loaded inserts can be screwed onto mounting studs in the die. An electrically operated multiple-head fixture is used for this purpose. Similarly, other inserts are extracted from the transfer plate after loading and positioned for loading into the bottom half of the mold. These inserts are ejected into the mold cavities by pins mounted on a spring-loaded plate. The mold is then returned to the press for the molding operation. At the end of



Schematic representation of assembly operation. *A* is the metal ring, *B* the glass bead, *C* the metal electrode

the cycle, it is again taken out of the press and the finished terminals are unscrewed from the mold pins with a powered fixture.

A much larger molded part for which the blow-loading machine could be profitably used is an automotive distributor cap molded of phenolic material. This part requires one type of brass or aluminum insert in the center and six or eight of a slightly different design spaced around the outside. These two varieties of inserts can be mixed in the oscillating drum and selectively loaded in the correct pattern through proper collector plate design.

Some molding jobs require two or more different types of inserts lying in different planes in the finished part. In such cases, two or more collector plates may be used, with the drum divided into two sections. The press operator would then handle each phase of the insert loading operation individually, somewhat as in the standoff terminal application cited above.

In some instances, the time required to fill the collector plate may exceed the molding cycle. In cases of this sort, it is possible to employ various methods to step up the loading of inserts by the machine.

In one approach, a single drum model is used with duplicate collector plates which are alternated, doubling the volume of loaded inserts available to the press operator. In another typical example, the collector plate used has 40 openings for a 20-cavity mold job, providing two mold patterns, slightly offset. Here 20 of the terminal inserts are removed from the collector plate at a time, leaving the remaining 20 ready for the next shot. Since the 40 terminals are loaded by the machine almost as fast as 20, considerable time may be saved by this method.

In still another approach, a two-drum model of the blow-loading machine may be used, with four collector plates rotated instead of two. Starting with the first plate, the press operator removes it from the drum and does the necessary work connected with it. The lower drum is then started again while the top drum is still oscillating. Then the same drum is parked while work is completed with the second collector plate, and so on. Thus, by using four plates with double loading patterns, it is possible to multiply the effective output of the machine by eight.

The versatility of the automatic blow-loading equipment stems from the wide variety of items, ranging from stampings to screw machine parts, which it can handle efficiently. A No. 10 threaded-stem insert, for example, can be loaded with ease if designed so that it will be accepted by the collector plate at one end and rejected at the other. Even long insert pins can be loaded on close centers relative to their length. Printed circuitry components are ideally suited for blow-loading: in a typical application, long, flat pins and short eyelets are both loaded automatically for efficient insertion into the printed circuit board.

In another terminal application, tiny stamped terminals are oriented for transfer into the laminated plastics part. All terminals are then riveted in a single operation. Still another application uses contacts which are loaded into a part after it is molded. A redesign of these parts will have the contacts molded into place. An outstanding example of how parts can be blow-loaded for an assembly operation involves glass-to-metal-sealed terminals for electronic equipment, in which a succession of collector plates is used to assemble 118 terminals, ready to be placed in an oven for the fusing operation. (See accompanying diagrams and photos on this and the preceding page covering this application.)

In adapting the blow-loading machine to existing molds, the usual procedure is to study the types of inserts involved and their location, then make up a collector plate which will follow the mold loading pattern if possible. Each molding assignment merits individual study, and profitable application of the blow-loading equipment appears limited only by the ingenuity of the molder.—*V.W.*

Mold temperature control —why and how

Tight dimensional and property tolerances on parts require close control of mold temperature; four plans of circulating-liquid control are described and compared

*By Robert W. Clark**

There are two principal reasons for maintaining accurate control of mold temperature: 1) to achieve maximum machine output and 2) to control physical properties of the moldings.

Temperature control has a direct relationship to the efficiency of injection molding equipment as well as to cycle time. As mold temperature increases over the range from about 90 to 150° F., flow resistance decreases and the cavity can be filled faster; this may reduce the cycle significantly in moldings requiring long flows. At higher temperatures there may be sticking of the piece in the mold because of packing and higher pressure. When the mold parts, the molding may be warped, scored, cracked, or damaged in other ways. On the other hand, a *low* mold temperature may also shorten the cycle if the set-up time is a large part of it—this was the case in the polyethylene molding reported in reference 1, p. 150. Low mold temperatures may also improve the strength and stiffness of the parts, particularly with polyethylene parts (references 1, 2). In some cases, however, a cold mold may produce stresses so severe that the piece has to be kept in the mold longer to prevent warping. Thus, the benefit of faster cycling is lost.

Physical properties of plastics can be better controlled when the mold temperature is controlled. The various properties of injection molded parts that are affected by temperature include weld strength, tensile modulus and strength, impact strength, and surface finish. Thermal stresses in the plastic can be reduced by proper temperature control. Surprisingly small point-to-point variations in mold face temperature can cause cracking and crazing.

Surface flaws which proper temperature control can reduce or eliminate include reticulation (orange peel) effects on high-impact polystyrene compounds, flow lines and weld marks, surface blisters, and "cottoning" or flaking-off of surface layers. To prevent orange peel, the molds must be kept warm enough to soften the plastic skin after its first chilling contact with the mold wall. The skin must be kept soft to conform to the mold surface while the cavity is being filled and pressure is increasing to hold the plastic against the mold wall. Weld marks can be ironed out the same way, provided the mold is adequately vented. Cottoning of cellulosics and polystyrene is most likely caused by the shrinking and shattering of the plastic skin when it touches a cold mold wall. Inside plastic heat then escapes so rapidly that the skin can't re-melt into the body of the molding. It then may flake off when completely cool. Obviously, where high-quality and/or high-volume production is involved, accurate temperature control is a must.

How control is achieved

Aside from the control equipment used, there are four primary factors which determine the

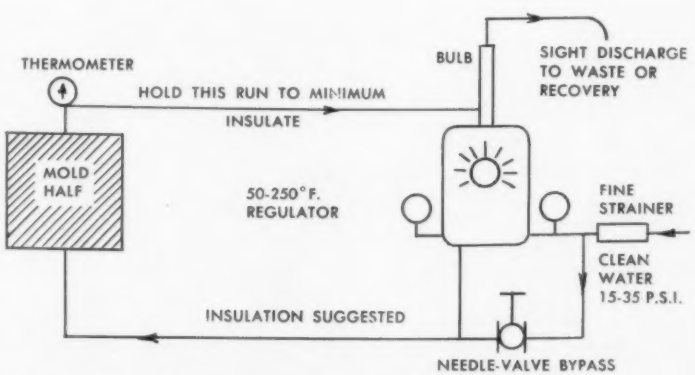


Fig. 1: Economical trickle control of mold temperature where velocity is 2 gal./min. or less is possible by using a regulator as a combination thermostat and valve. Bulb of regulator gradually positions a valve in regulator to throttle flow of water as needed. Needle-valve bypass assures a minimum trickle of water through mold and over bulb. Otherwise, with valve fully closed, no water would flow over bulb and rate correction be prevented

*Engineer, The Powers Regulator Co., Skokie, Ill.

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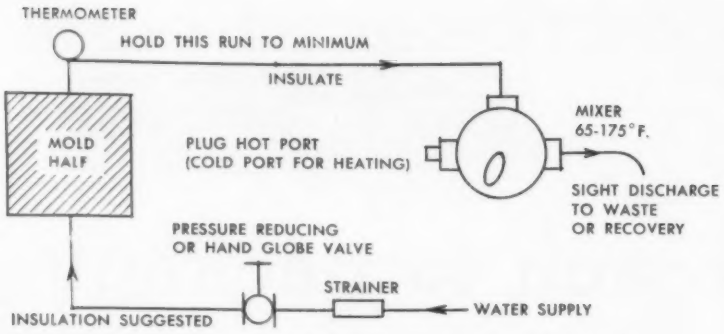

Fig. 2: The mixer in an installation for flow rates greater than 2 gal./min. has a bellows-operated thermostatic element which throttles flow of water leaving mold. Thus, as mold heats up, more water is drained off, permitting more to enter and carry off heat. As temperature drops, water flow is slowed. Mixer can be used for cooling or heating, but not both simultaneously

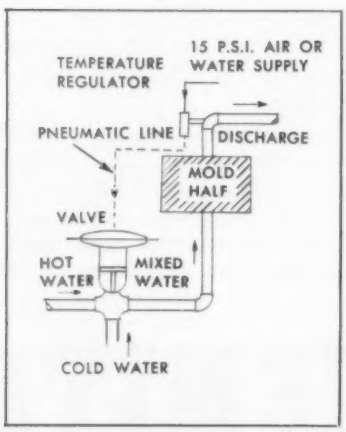

Fig. 3: In constant-velocity temperature control system, hot and cold water are thermostatically blended while constant flow rate is maintained. Thermostatic bulb of regulator is mounted in drain line and pneumatically transmits temperature variations to three-way valve. Hot and cold water in correct proportions are mixed and delivered to mold half. Same system can be used for cooling and heating

degree and accuracy of mold temperature control. These are the nature of the heat carrier, its velocity of flow, its flow path, and the insulation of lines.

1) *Heat carrier.* Selection of the heat carrier is based on two considerations: first, compatibility of its temperature range to the plastics-processing temperatures involved, and, second, its heat-transfer properties. Because of their better transfer characteristics and much higher heat capacity on a volume basis, liquids are far superior to gases as mold circulants. The operating temperature ranges over which some of these liquids have been used are listed in Table I, below. In choosing the heat carrier, the engineer must also consider pumping requirements, leakage characteristics, decomposition, fire and toxicity hazards, and corrosion.

Water is the most generally used heat carrier, since it has the highest heat transfer coefficient and specific heat. For temperatures over 350° F., however, high pressures are required. In the following discussion, water is assumed to be the carrier; thermal principals involved apply as well to other circulants.

2) *Velocity of flow.* A constant high-velocity flow of the heat carrier is one of the most important factors in close control of temperature. Where the rate of liquid flow is throttled, the uniformity of surface temperature suffers, control becomes sluggish, and regulation of temperature becomes less accurate. Aside from the effects that control equipment may have on velocity, the two most common causes of poor velocity control are drains on the supply line by other equipment, and varying city water pressure.

Very often an engineer planning to install automatic mold temperature control will ask: "Just how close must I hold my pressure tolerances?" The answer is another question: "What temperature tolerance can you afford to provide?" Obviously, it costs less to tap four injection molding machines off a central cold or hot water line than it does to provide a line for each. But each tap is a potential source of pressure variation. To assure constant pressure, each machine should have a reducing valve. Similarly, a pressure reducing valve is often a satisfactory answer to variations in city water pressure.

3) *Flow path.* The size and directness of the passage is of greatest importance, since uniformity of flow should be maintained throughout the mold. These factors are related to the quantity of liquid that must be circulated, which in turn is based on the amount of heat that must be added or removed, the permissible temperature change in the carrier between entering and leaving the mold, and the specific heat of the liquid. The circulation passages should be sized so as to

Table I: Liquid heat carriers

Carrier	*Recommended temperatures* — *Minimum*	*Maximum*
	°F.	°F.
Water	40	400-450
Heat-transfer oils	100	500-550
Diphenyl chlorides	50	550-600
Aryl silanes	0	600-650
Diphenyl, diphenyl-oxide mixture	70	750-800
Tetracresyl silane	50	750-800
Eutectic salts	320	1000-1200

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get the best heat transfer at the available pressure drop and mass rate of flow. Liquid velocities must be high if high convection coefficients and low temperature drops across the heat path are to be obtained. However, since much of the resistance to heat transfer between the plastic and the circulant is due to the plastic, the heat-transfer coefficient of the circulant is not as critical as in many non-molding heat-transfer problems. In some cases it may be desirable to arrange and size the channels so as to provide more cooling in some regions than in others. Some examples of this technique are given in reference 2.

4) *Insulation.* The piping supplying the heat carrier to the mold must be properly protected to guard against heat loss or gain due to temperature changes in and movement of the air in the room. The discharge line, which is the usual place for mounting the temperature-sensing device of the controlling instrument, must also be insulated. For fast, reliable response, the temperature-sensing device should be located as close to the mold as possible. Like pressure tolerance, supply temperature tolerance is often a matter of what variation the user can allow. Where hot and cold water temperatures vary widely, the mold temperature control problem becomes more difficult. Variations of this kind can be more easily controlled if pipes supplying the water are insulated.

Temperature control systems

Four different systems of temperature control have been used for injection molding:

1) *Uncontrolled cold water.* Cold water is kept constantly flowing through the mold, with no attempt made to control its velocity or temperature. The objective is simply to carry off heat. This system is inflexible and wasteful of water, and has been abandoned by the majority of molders.

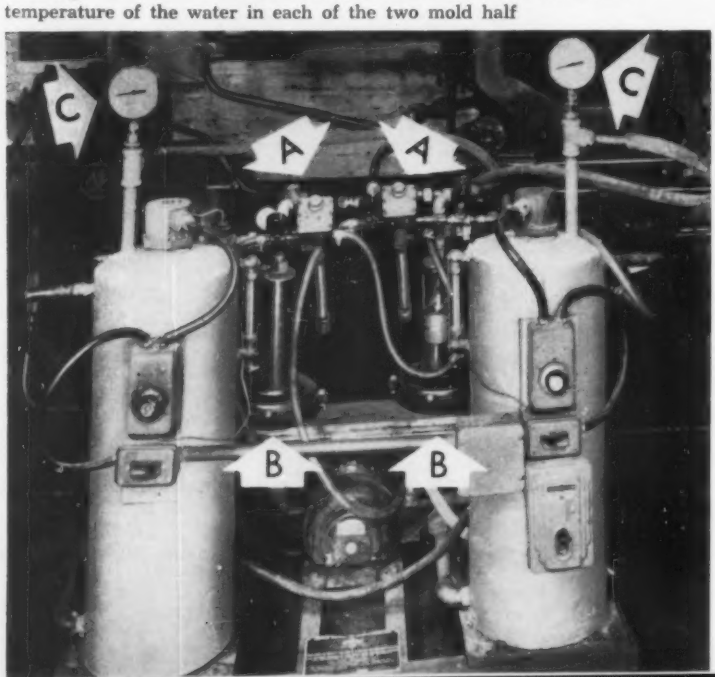
2) *Hand-valve control.* Modulated velocity control using hand valves is still common. Again, cold or hot water is used as the heat carrier, but its flow is varied manually. However, the operator must first experience rejects before knowing when to readjust the valve.

3) *The trickle system* varies the flow of water automatically through the mold. As the mold heats up, more water is admitted. When temperature returns to the desired point, water flow is reduced.

4) *The constant-velocity system* maintains the water flow at a constant rate, but the temperature is varied by mixing hot and cold water automatically, as the mold temperature demands.

Since the trickle and constant-velocity systems provide the most accurate control, they will be discussed in detail.

Fig. 4: Packaged hot water and central cold water are provided by this mixing arrangement used by Sinko Mfg. and Tool Co., Chicago, Ill., for its injection molding machines. Each mold half has its own 5-gal., 6-element heater. The hot water from the heater and the cold water from the central supply are blended by diaphragm valves (B). These valves are pneumatically controlled by regulators (A) whose temperature-sensitive bulbs are mounted in the discharge line. Dial thermometers (C) are used to indicate the temperature of the water in each of the two mold half



Trickle system

In 1949, Powers Regulator, working with others in the plastics industry, introduced the first trickle unit. This consists of a thermostatic valve that remains closed until the temperature reaches a set point. Then the valve opens automatically and allows a trickle of new water to enter the mold as needed, until the temperature reverses past the set point. This system can be used for heating or cooling the mold, but not both simultaneously. It would not be satisfactory by itself, for example, for regulating the temperature of a mold being used in compression molding a thermoplastic, where temperatures must be cycled alternately.

The most serious drawback of the trickle system is that its varying water velocity is apt to cause hot and cold spots on the face of the mold. This tendency becomes more pronounced when the molded part is complex, requiring finer channeling of the water passages. A further drawback is that the control achieved is not very close—about 10° F. For these reasons, the trickle system is not adapted to the production of high-quality injection moldings, where closest consistency of shape, dimensions, color, and physicals are demanded. On the positive side, the trickle system costs from 25 to 75% less than a comparable constant-velocity system. In many cases, cost alone

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will dictate the use of trickle control.

Figures 1 and 2 illustrate two methods of trickle control, one where the flow rate is 2 gal./min. or less, the other where the flow rate is greater than that. In Fig. 1, p. 144, the regulator is used as a combination thermostat and valve. Clean cooling or heating water is piped to the supply port of the regulator. Water discharged from the mold passes over a bulb which is filled with a volatile liquid. Any temperature variation in the discharge water will affect the pressure in the bulb. This pressure change is transmitted directly to the valve in the regulator, which gradually opens or closes to regulate the flow of the water entering the mold. Note that the temperature-sensing bulb should be mounted as close to the mold half as possible, to minimize any temperature drops between the mold and the bulb. Insulation is also suggested for the supply line. The regulator is adjustable over a range of 50 to 250° F.

Where the maximum flow rate is more than 2 gal./min., a mixer is advised, as shown in Fig. 2, p. 146. One such mixer, the Hydroguard, is adjustable over a 65 to 175° F. range. Its internal thermostatic element automatically throttles the flow of water from the mold as needed to keep temperature constant.

Constant-velocity system

As explained earlier, a requirement for accurate temperature control is a constant flow rate of the heat carrier. The constant-velocity system meets this requirement. It provides temperature control by varying the temperature, not the velocity, of the water. With this system, temperature control is possible to within approximately ± 0.5° F. This is accurate enough for the most demanding molding job. Obviously, the constant-velocity system is required where quality, color, dimensional, and strength tolerances must be close.

Cost is higher than for a trickle system. In some cases, however, cost can be reduced by using central cooling and heating, instead of providing separate packaged facilities for each molding machine. With central facilities, hot and cold water lines from a single source running above each line of machines are tapped at each machine, which has its own set of controls. The first cost is much less than that of packaged systems, and saves valuable floor space. Figure 3, p. 146, shows a typical constant-velocity arrangement. A thermostatic bulb is mounted in the mold discharge line. Temperature variations are transmitted pneumatically to the diaphragm valve which gradually positions a three-way valve to mix hot and cold water in necessary proportions while maintaining a constant flow rate. A variety of temperature ranges is available.

Even closer control is possible (though perhaps seldom justifiable) with a closed circulation system. In many cases, the water used in a constant-velocity control system is drained away after it leaves the mold. The system is thus constantly drawing on fresh water to circulate through the mold. During the course of a year, this fresh water may vary considerably in temperature. Differences of 40°F. between winter and summer water temperatures in the northern half of the United States are not uncommon. This wide variation may necessitate more elaborate controlling equipment. In a closed system, the water is at a constant temperature the year round. After leaving the mold, the water is recovered, filtered if necessary, heated or cooled as needed, and recirculated. Another advantage of the closed system is that smaller heating and/or cooling units can be used. This is because the heating and cooling job is usually not as great with recirculated water as it is with fresh water. A third advantage is that a closed system prevents impurities from entering the water. In certain areas, sand, silt, rust, etc., are often found in city water. Finally, in these days of growing water scarcity, the closed system definitely saves water. Over a year, the savings can be substantial and may even pay for the added cost of a closed system.

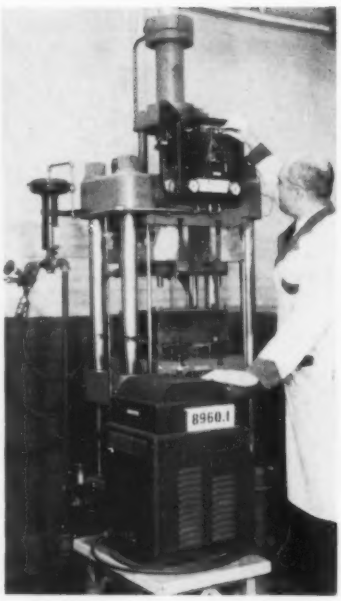

Fig. 5: Compression molding machine at Bell & Howell Co., Chicago, has central hot and cold water thermostatically blended for accurate temperature control. Operator is adjusting indicating controller, which pneumatically links to valve (left) blending two water supplies. By varying proportion of hot and cold water equipment automatically maintains correct mold temperature

Such a constant-velocity system is in use at Sinko Mfg., and Tool Co., Chicago (see Fig. 4, p. 148). On its 11 injection molding machines, Sinko provides packaged hot water and central cold water. The hot water is supplied from individual 5-gal. heaters with six elements for each mold half. The discharge, which consists of mixed hot and cold water, is returned to the hot water tank, while the overflow is wasted. Figure 5, above, shows a constant-velocity system applied to a compression press.

References

1. C. S. Imig, "Mold temperature effects in polyethylene molding," MODERN PLASTICS 34, 149 (Dec. 1956).

2. J. V. Smith and J. N. Scott, "Injection molding rigid polyethylene," MODERN PLASTICS 35, 149 (Sept. 1957).

Report on S.P.E. Retec on hot-runner and runnerless molding

Like other technical societies, the S.P.E. is faced with growth problems. Its annual technical conference, which this year will be running four sessions in parallel for three and a half days, cannot adequately handle the mass of information developing on plastics engineering. On the other hand, it is difficult to get qualified experts to speak at meetings of single sections, of which there are now 38. A nice compromise is the regional technical conference, (Retec), inaugurated this year. The Retec is devoted to a limited topic, and attracts attendees from many sections in the region. The first three Retecs have shown leaping improvement, both in organization and in quality of material.

The second Retec, held at Niagara Falls on September 27, offered speakers on mold design for automatic molding. Some or all of these talks will probably appear in official S.P.E. publications soon, so they are only summarized here. The titles were:

1) *"Review of the field of hot-runner molding,"* by Ernest P. Moslo, Moslo Machinery Co.

2) *"Automation phases of plastics molding,"* by John A. Kavanagh, Standard Tool Co.

3) *"Molding materials for present and future molding techniques,"* by Richard W. Miler, The Dow Chemical Co.

4) *"Practical hot-runner molds, Part II,"* by Joseph R. Grenier, Protective Closures Co.

All four speakers stressed the importance of reliability of performance to successful molding automation. Unless the mold is carefully engineered for near-100% reliability in continuous service, the "automatic" operation may cost more money than it can save. Since the problem of what to do with sprues and runners becomes more than a nuisance in automatic molding, the trend has been toward their elimination, i.e., hot-runner and runnerless molding. In reviewing the past of hot-runner molding, Mr. Moslo said that hot-runner molds seemed well-suited to the molding of polyethylene and polystyrene, but not very successful with other resins. Mr. Miler also confined his discussion to those two classes of materials. Mr. Grenier showed drawings of several molds that had been used with various other resins, while Mr. Kavanagh went further, saying that nylon was the only thermoplastic he considered impractical to hot-runner mold, because of its tendency to drool. (Type 6 and high-viscosity type 6/6 nylons will probably be OK —*Ed.*)

High spots of talks

Mr. Moslo reviewed the development of hot-runner molding, pointing out that a big problem has been keeping the hot parts of the mold hot enough and the cold parts cold enough. Much ingenuity has been devoted to overcoming this problem.[1, 2] Since most hot-runner molds are filled very rapidly, good venting is a must. Vacuum venting[3] has been very successful.

"It is generally more important to properly cool the core than it is the cavity," said Mr. Moslo. Where drilling a cooling channel might weaken a thin core, an ingenious compromise is to drill a hole into which is pressed a beryllium copper rod. Cooling water contacts the outer end of the rod, whose high conductivity transmits the cold along the length of the core.

Mr. Kavanagh pointed out that automatic molding machines have been available for many years, but it is only within the last few years that much attention has been given to building automatic molds. It is now possible to build molds with sufficient reliability so that one man can manage up to 12 machines doing different jobs. Ejection is the key: generous use of knockout pins, stripper rings, air sweeps, clearing fingers, etc., all help to reduce interruptions and mold damage. Safety devices that stop the clamping ram when the parts fail to eject are worthwhile damage preventers.

For automation, the mold should be the best that can be built extra rugged, carefully thought out. Such a mold will cost about 10% more than a mold satisfactory for semi-automatic operation. "There is no item that cannot be hot-runnered." However, hot-runnering adds about $900 to the mold cost.

Mr. Miler listed the characteristics desirable in a hot-runner-molding resin: wide softening-temperature range, high heat-distortion temperature, ease of flow under pressure at low temperatures, high heat conductivity, and low specific heat. The reasons for wanting these qualities were explained in detail, and charts comparing flow properties of different resins under development were shown. Polyethylene and polystyrene were compared with each other as hot-runner molding materials.

Mr. Grenier made this encouraging statement: "If the mold is properly designed to eject the parts, no special wipers or combs are required on the press." Low-temperature, large-area heat sources give more even distribution of heat than hot, small ones, and "for best operation, there should be as many heaters of as high wattage as possible in the hot plate . . . the molds won't work with insufficient heat." Some of his company's standardized molds were discussed with the aid of drawings.

---

[1] "Automatic high-speed injection molding," by E. P. Moslo, SPE J. *10*, 12 (May 1954).

[2] "Runnerless injection molding," by E. P. Moslo, MODERN PLASTICS 32, 119 (April 1955).

[3] "Vacuum-venting of molds," by G. S. Bohannon, MODERN PLASTICS 34, 162 (Dec. 1956).

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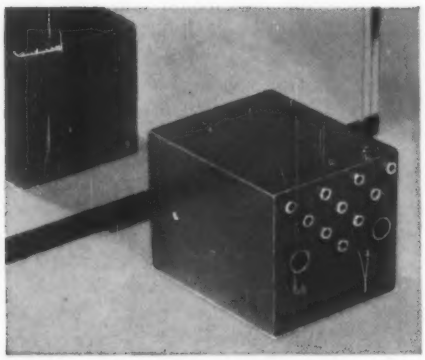
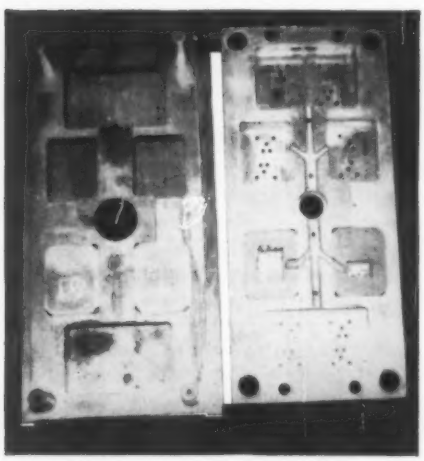


Electrical components are firmly embedded and hermetically sealed by Maraset encapsulating resins . . . as in this use by Cosmos Industries, Inc., Long Island City, N. Y., to protect a delicate filter unit from shock, heat, moisture, and contamination.



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Dr. Gordon M. Kline, Technical Editor

Polyacetal resin—
a new engineering material

This linear, highly crystalline plastic has substantial strength and stiffness even at 240° F.; is resistant to almost all organic solvents; and exhibits high strain recovery, low creep rates, and excellent wearing qualities

Excepting the silicones and cellulosics, most of the familiar thermoplastics are vinyl (or ethenic) polymers whose molecules are long saturated chains of carbon atoms. Nylons have a nitrogen atom in the chain, the ratio being one nitrogen for each six carbons in the commonest nylons, type 6/6 and type 6. Silicones, with their chains of alternating silicon and carbon atoms, are structurally most similar to the new Delrin[1] acetal resin, an organic polymer whose mer, or chain-structure unit, is $-CH_2O-$. Thus the chain is made up of alternating carbon and oxygen atoms. Since there is very little, if any, chain branching, and since the hydrogens on the carbon have not been replaced with larger radicals, as is usually the case in the silicone resins, this polyacetal resin is linear and highly crystalline, exhibiting the relatively sharp melting point and good high-temperature properties characteristic of other crystalline, linear plastics. Its natural color is opaque white. In many respects it resembles nylon-6/6, but its moisture absorption is much less and it has greater retention of stiffness and strength at high temperatures and humidities, in contact with solvents, and under prolonged stress.

Chemists will have noticed that the polyacetal mer has the same empirical formula as formaldehyde, HCHO; if they were to conclude that polyacetal is made by polymerizing formaldehyde, they would be absolutely correct. To those familiar with formaldehyde chemistry this will be a startling conclusion. While low-molecular-weight polymers of formaldehyde have been known for many years, a great deal of

Plates and tumblers molded of polyacetal have good resistance to staining, can be cleaned in automatic dishwashers. (Photo Du Pont)

[*]Reg. U.S. Pat. Off.
[1]Delrin is a registered trademark of the Du Pont Co.

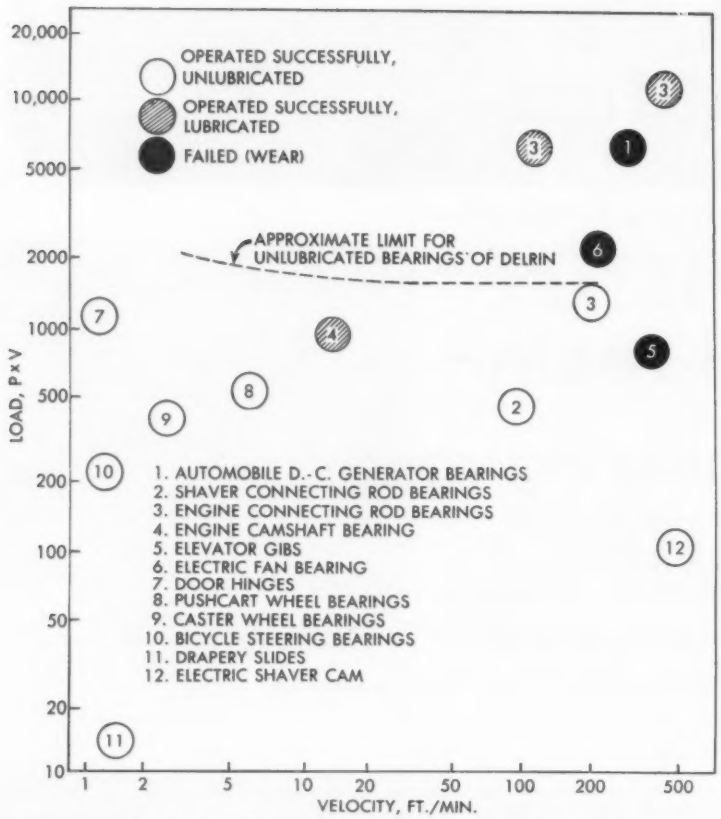

Fig. 1: Load-speed "map" of journal bearing experience with polyacetal resin. The few failures were due to abrasive wear. D.-C. generator bearing, though worn, was still running well after equivalent of 40,000 miles. (Charts, Du Pont)

first-rate laboratory work has been done to produce high polymers.[2] However, synthesis of polyformaldehyde has recently been announced and developmental quantities are now available.

Various applications of Delrin have been field-tested during the past three years. Here are the details of a few of these applications: 1) A connecting-rod sleeve bearing for a ¾-hp. gasoline engine operated at 170° F. under a load of 20 p.s.i. and at a surface velocity of about 450 ft./min. was in excellent condition after 70 hr. of operation. This time would correspond to about two years' use in a power mower. Tests of this and many other bearing applications indicate that the operating PV (pressure-velocity) limit for unlubricated polyacetal is about 1600 p.s.i., ft./min. Lubricated bearings, as Fig. 1, left, shows, can sustain much higher loads.

2) Gears for a movie projector ran for 2000 hr. with no sign of wear and without jamming at high temperatures and humidities. Water sprinkler gears have given no trouble in operation through two summers. An auto speedometer take-off gear, operating in grease at about 130° F., ran 12,000 miles over 17 months with no sign of wear. Food mixer gears of polyacetal outlasted two motors and showed no sign of wear when compared with unused gears from the same batch. Figure 2, below, is a chart showing gear service conditions at which polyacetal has been tested. Of course these gears run much more quietly than their steel counterparts.

3) Tableware: polyacetal plates, cups, knife handles, and tumblers all showed much better resistance to staining than melamine ware, though dishes were more deeply marked by knives. Two years of washing in automatic dishwashers

[2]See, for instance, the ACS Monograph No. 120, "Formaldehyde," 2nd Ed. by J. F. Walker, Reinhold Publishing Corp., New York, 1953.

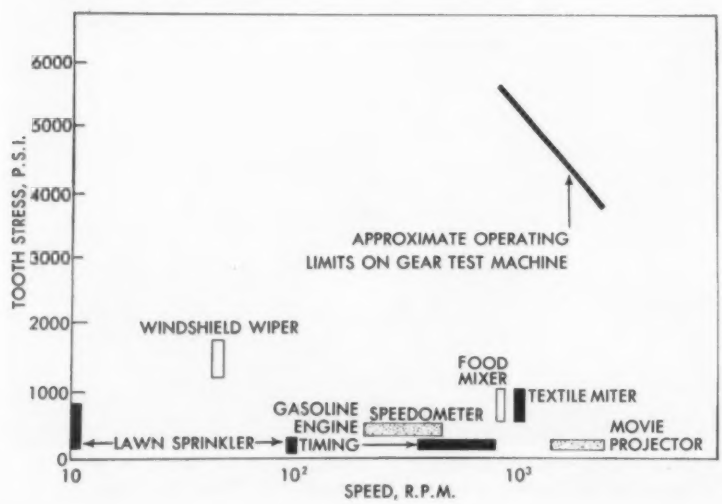

Fig. 2: Load versus speed for polyacetal gears running in gear tester and in assorted applications. Testing machine results suggest that polyacetal may be useful in much heavier-duty applications than have so far been tested

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had had no visible deleterious effect.

4) Polyacetal football cleats were used by four players on a university team, who also wore some conventional hard-rubber cleats on the same shoes. At the end of the season, the polyacetal cleats had worn less and were smoother than the rubber ones.

5) Eight polyacetal actuator cams for an electric typewriter, installed on the most frequently used keys, showed no sign of wear after 22 months of constant use; although these cams are very thin, no metal insert was required to provide the necessary rigidity.

6) Because of its low permeability to organics, polyacetal makes a good aerosol-container material. A number of 2-oz. containers (wall thickness 45 mils) were allowed to stand for a year

Table I: Typical properties of molded Delrin

Property	*A.S.T.M. No.*	*Delrin 500X*[a]	*Zytel 101 nylon-6/6 (conditioned to 2.5% moisture)*	*Tenite II cellulose acetate butyrate (hard) H4-1*
Tensile strength, p.s.i.	D-638			
—68° F.		14,700	15,700	
73° F.		10,000	10,500	6,500
158° F.		7,500	ca. 8,000	5,400
Elongation, %	D-638			
—68° F.		13	1.6	
73° F.		15	90	42
158° F.		330	300	
Flexural modulus, p.s.i.	D-790			
73° F.		410,000	210,000	190,000
170° F.		190,000		
250° F.		90,000		
100% R.H., 73° F.		360,000		
Impact strength, Izod, ft.-lb./in. of notch	D-256			
—40° F.		1.2	0.4	0.4
73° F.		1.4	2.0	0.8
Impact, strength, tensile, ft.-lb./in.[a]				
73° F.	Non-standard[b]	133	365	167
Flexural strength (yield), p.s.i.	D-790	14,100	14,000	8,600
Shear strength, p.s.i.	D-732	9,510	9,600	
Deformation under load, % *(2000 p.s.i. at 122° F.)*	D-621	0.5	1.4%	<3%
Heat distortion temperature, °F.	D-648			
264 p.s.i.		212	150	
66 p.s.i.		338	360	188
Fatigue endurance limit, p.s.i.	Non-standard axial			
70° F., 50 to 100% R.H.,	completely reversed	5000		
150° F., 100% R.H.	stress—1800 c.p.m.	3000		
Water absorption, %	D-570	0.41	1.5	2.1
Specific gravity	D-792	1.425	1.14	1.23
Rockwell hardness	D-785	M94, R120	R118	R116
Flammability, in./min.	D-635	1.1	Self ext.	1.0
Creep rate in flexure at 73° F., in./in. hr.	Non-standard			
2000 p.s.i.		6×10^{-6}		
3000 p.s.i.		7×10^{-6}		
Melting point (crystalline), °F.	Non-standard	347°	492	329
Flow temperature, °F.	D-569	363°	>480	
Compressive stress at 1% deformation, p.s.i.	D-695	5,200	4,900	
Taber abrasion (1000-g. load, CS-17 wheel), mg./1000 cycles	D-1044	20	6	ca. 80
Coefficient of linear thermal expansion, per °F.	D-696	4.5×10^{-5}	5.5×10^{-5}	8×10^{-5}
Thermal conductivity, B.t.u./hr./sq. ft./°F./in.	Non-standard	1.6	1.7	1.7
Specific heat, cal./g.	Non-standard	0.35	0.4	0.35

[a]These values are representative of those obtained under standard A.S.T.M. conditions and should not be used to design parts which function under different conditions.
[b]Tensile-impact values for many materials were listed in "Tensile-impact: a simple, meaningful impact test," by C. G. Bragaw, Modern Plastics *33*, 199 (June, 1956).

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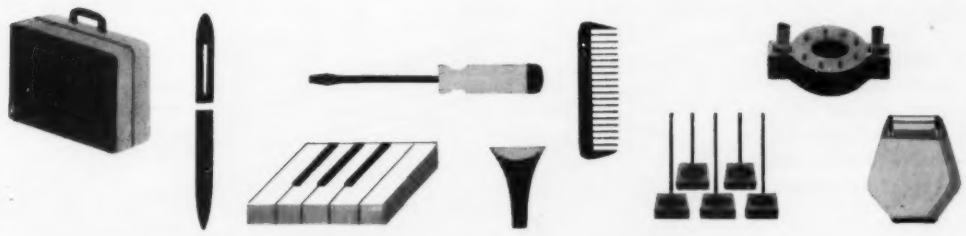

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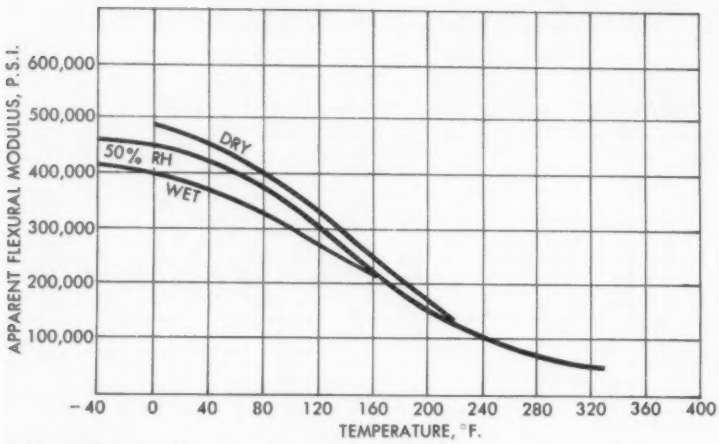

Fig. 3: Flexural modulus of acetal resin as function of temperature

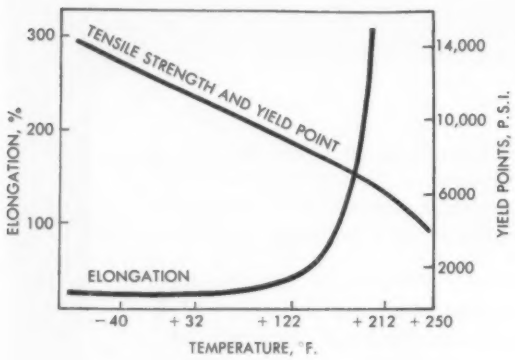

Fig. 4: Effects of temperature on tensile properties of polyacetals

after being loaded with cologne or shaving lather. At the end of that time none showed distortion and all contained enough propellant to discharge the entire contents. A similar test conducted at 130° F. for three months revealed some weight loss, but bottle contents were still completely dischargeable.

The results of these and many other field tests show that polyacetal resin is well-suited to many jobs requiring combinations of engineering properties. The question of price factors has been discussed in MODERN PLASTICS 35, 284 (Oct. 1957), and it appears even now that in spite of its relatively high specific gravity of 1.425, polyacetal will offer an attractive amount of serviceability per dollar.

Mechanical properties

The physical properties of Delrin acetal resin are listed in Table I, p. 156. To provide a familiar basis of comparison, properties of Zytel 101 (type 6/6 nylon) and Tenite II (type H4-1, hard cellulose acetate butyrate) are also given. The table reveals that polyacetal is a strong, tough material with exceptionally high stiffness. Measurements of weight loss in various abrasion tests indicate that polyacetal is inferior to nylon in this respect but superior to most other hard plastics. It retains almost one-fourth of its room-temperature stiffness at 250° F. and has very high heat-distortion temperatures.

Coefficients of friction for polyacetal on polished steel range from 0.1 to 0.3 for unlubricated surfaces down to 0.05 to 0.1 for oil-lubricated surfaces.

Polyacetal has good strain recovery: even at 150° F. and 100% R. H., when loaded to 10% elongation for 1 min., it returns to 1.5% elongation in the first minute after the load is removed and eventually recovers almost completely. At room temperature, recovery is as good or better. This property makes polyacetal suitable for snap-fit assemblies and for moldings requiring some degree of undercut.

Figures 3 through 6 show how the mechanical properties of polyacetal vary with changing environmental conditions, while Figs. 7, 8, and 9 present graphs relating to its creep characteristics. Apparently polyacetal creeps extremely slowly at 73° F. at stresses under 5000 p.s.i., but ruptures in less than 1000 hr. at stresses over 6000 p.s.i.

Thermal and electrical properties

The thermal properties of polyacetal, also listed in Table I, are about equal to those of other thermoplastics and compare closely with those of nylon and butyrate. Its electrical properties, except perhaps for the dissipation factor, are good but not extraordinary. The short-time dielectric strength is 500 v./mil, volume resistivity is about 6×10^{14} ohm-cm. and depends slightly on the water content of the resin, while surface resistivity is 2×10^{13} ohms. The arc resistance of polyacetal is 129 seconds. Over the frequency range from 0.1 to 10 kc., at 73° F., the dielectric constant and dissipation factor re-

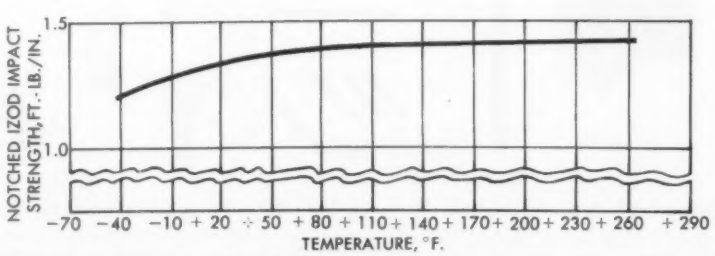

Fig. 5: Notched Izod impact strength of acetal resin is almost constant over whole temperature range from −40 to 260° F.

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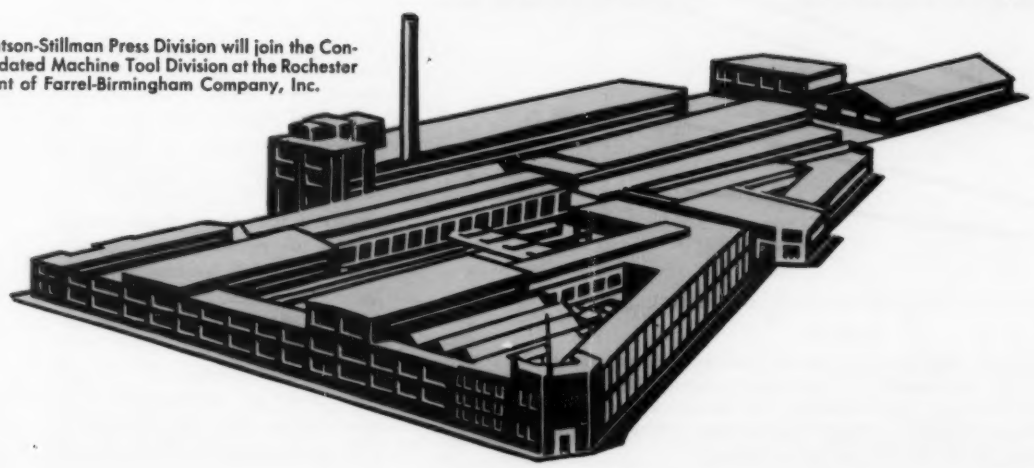

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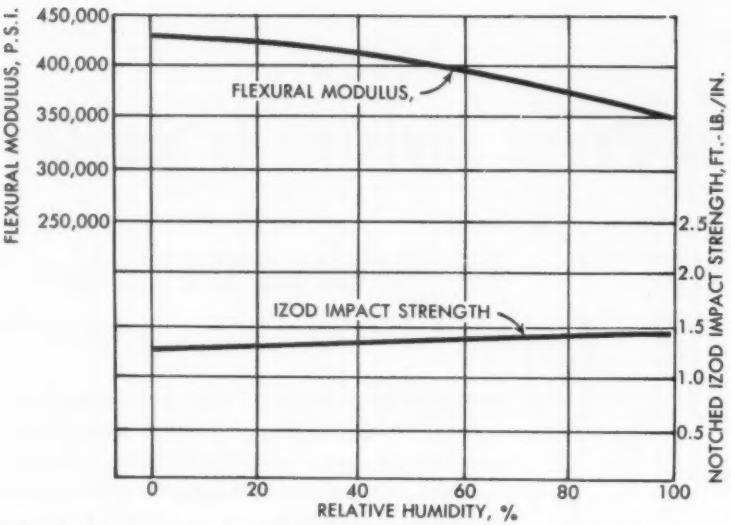


Fig. 6: Flexural modulus and Izod impact strength of acetal resin are not strongly affected by changes in humidity

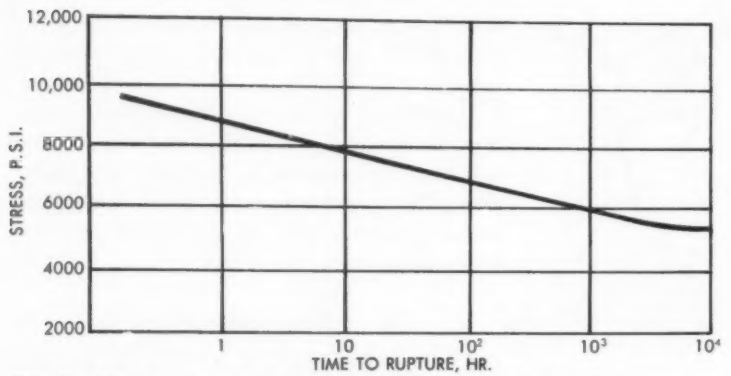


Fig. 7: Ultimate strength of acetal resin depends on the length of time it is kept under stress. There were indications that parts made of this resin will enjoy very long life at tensile stresses below 5000 p.s.i.

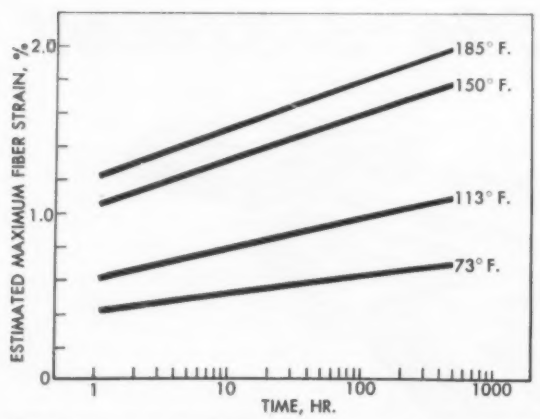


Fig. 8: Creep in flexure of polyacetal at various temperatures; this (non-standard) test consists of applying a concentrated load at the center of a 4-in. span and measuring the change in center deflection with time. From this change, the amount of stretching of the under-surface of the beam can be estimated

main constant at 3.7 and 0.004, respectively. At a frequency of 830 kc., the dielectric constant is 3.5, but the dissipation factor remains the same.

Chemical resistance

Polyacetal resin does absorb moisture, the amount, as usual, depending on the conditions. At 73° F. and 50% R.H. the equilibrium quantity is 0.24%; if the sample is immersed in boiling water, the figure jumps to 1.75 percent. The rate of moisture pick-up also increases with increasing wetness of the surroundings and, of course, with rising temperature. The graphs of Fig. 10, opposite, show the dependence of pick-up rate and equilibrium moisture content on these factors. While the moisture absorption of polyacetal is considerably greater than that of polyethylene and polystyrene, it is about equal to that of methyl methacrylate resin and rigid PVC, and is much lower than nylons and cellulosics.

This absorption of water is accompanied by expansion of the resin amounting to about 1 mil/in. for a moisture gain of 0.22 percent. Polyacetal also expands with increasing temperature, as do all other resins. Figure 11, p. 245, gives the percentage increase in length to be expected at any combination of these factors, the dimension when bone dry at 77° F. being taken as the unit of length. To find the change in dimensions accompanying a permanent change in the environmental conditions, the percent increase corresponding to each set of conditions is read off the graph and the value for the original conditions is subtracted from the value for the new conditions. To make the graph handier, the curves of equilibrium water absorbed *vs.* temperature for three basic moisture conditions have been drawn in. It should be emphasized that these three curves apply to *equilibrium* moisture values. In thick sections, particularly, the moisture content may take weeks and even months to reach equilibrium.

Over the course of a year's variations in temperature and humidity, a thick polyacetal part will suffer considerably less vari-

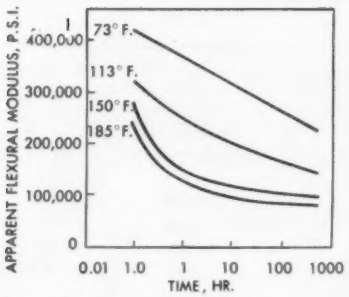


Fig. 9: Another way of looking at creep behavior. Applied stress is divided by total strain after any given time to give apparent modulus appropriate to interval of time

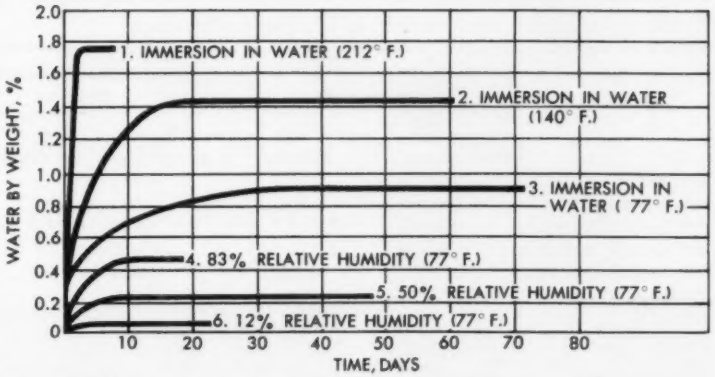


Fig. 10: Water pick-up of acetal depends on moisture conditions and time of exposure. Curves 1, 2, 3, and 5 were obtained from 5- by ½- by ⅛-in. bars; 4 and 6 from ⅛-in.-cubic molding powder. Maximum pick-up at room temp. and 50% R.H. is 0.2 percent

ation in moisture content than the equilibrium values would indicate, and the dimensional changes will be correspondingly smaller. Conversely, in films, wire coatings, monofilaments, and thin-walled moldings, water content will respond relatively fast to changes in humidity although the total pick-up is small.

The new plastic has greater solvent resistance than any thermoplastics except the fluorocarbons. This behavior is summarized in Table II, below, which gives the changes in tensile strength, weight, and length of test specimens immersed for a year in 11 organic reagents. Samples were exposed at room temperature and at either 122 or 158° F., depending on the volatility of the test reagent.

The results of similar measurements in which common inorganic reagents were used are reported in Table III, p. 162. They reveal that polyacetal suffers large weight losses when exposed to the action of strongly acid solutions for six months, even at room temperature, and this weight loss is accompanied by a loss in strength. Basic solutions seem to be less damaging. At present, for applications involving even the milder acids, polyacetal should be tested under actual service conditions.

A corollary of polyacetal's good solvent resistance is its resistance to staining by coffee, tea, catsup, vegetable dyes, lemon juice, lipstick, and similar offenders. The material is non-toxic and safe for use in eating utensils, though it has not yet been approved by the Food and Drug Administration as a food packaging material. Rats fed massive daily doses for two weeks suffered no organic damage.

Many polymers undergo "crazing" or "stress-cracking" when they are stressed while in contact with solvents. Even in the absence of external stress, crazing may occur because of stresses frozen in during molding. Some materials will fracture after a few minutes' contact with a solvent when stressed to 20% of their ultimate strengths. In extreme contrast to this behavior, polyacetal has demonstrated excellent resistance to crazing or stress-cracking by organic solvents. Test bars have been stressed to just below their break point and submerged in tol-

Table II: Resistance of Delrin to organic chemicals[a]

Reagent	*Percent change in 12 months*					
	Tensile strength		*Weight*		*Length*	
	Room temperature	*158° F.*	*Room temperature*	*158° F.*	*Room temperature*	*158° F.*
50% Igepal	+2	−58	−1.8	+0.1	+0.05	−1.21
"Nujol"	+1	+ 2	+0.3	−0.5	−0.08	−0.37
"Uniflo" motor oil 10W30		+ 3		−0.2		−0.30
Carbon tetrachloride	−3	− 7[b]	+1.2	+5.7[b]	+0.30	−0.25[b]
100% Ethyl alcohol	−5	− 5[b]	+2.2	+1.9[b]	+0.81	+1.00[b]
Acetone	−5	− 7[b]	+4.9	+2.6[b]	+0.91	+1.08[b]
5% Acetic acid	0	− 8[b]	+0.8	−2.6[b]	+0.15	−0.22[b]
Toluene	−7	− 7[b]	+2.6	+2.8[b]	+1.20	+1.20[b]
"Super 9" brake fluid		− 6		+1.6		+0.57
"Lockheed 21" brake fluid		−23		+0.9		+0.29
Ethyl acetate	−7	− 7[b]	+2.7	+2.9[b]	+1.35	+1.10[b]

[a]Test conditions:
1. Bars were completely immersed in solvent for time indicated.
2. Tests were made by standard A.S.T.M. procedures at room temperature immediately after removal of bars from solvents.
[b]Because of difficulties in carrying out the test these samples were tested at 122° F. instead of the higher temperature.

Table III: Resistance of Delrin to inorganic chemicals[a]

Reagent	Percent change in six months — Tensile strength		Weight		Length	
	Room temperature	158° F.	Room temperature	158° F.	Room temperature	158° F.
30% sulfuric acid	−>30		−48			
10% nitric acid	−>30		−70		−1.00	
10% hydrochloric acid	−>30		−84		−1.91	
10% sodium hydroxide	0.0		+0.01	1	+0.02	
10% sodium-chloride	0.0	+1.0	+0.05	+0.02	+0.01	0.00
Buffer soln., pH4		−>60		−>20		
Buffer soln., pH7		−1.0		−0.05		−0.22
Buffer soln., pH10		−3.2		−0.83		+0.02

[a]Test conditions:
1. Bars were completely immersed in solvent for time indicated.
2. Tests were made by standard A.S.T.M. procedures at room temperature immediately after removal from solvents.

uene, carbon tetrachloride, acetone, ethyl acetate, brake fluid, new and used motor oils, buffer solutions of ph 4 and 10, and water solutions of 5% acetic acid, 20% phenol, 37% formaldehyde, 10% sodium chloride, and 25% Igepal detergent. After one week, there was no indication of crazing in any specimen. As with the metals, stressed sections of Delrin are particularly susceptible to stress-corrosion by acidic or strongly basic media.

Permeability

The permeability of polyacetal to many organics is only a fraction of that of polyethylene, but it is much more permeable to water vapor than polyethylene. To test permeability, 4-oz., blow-molded, Boston Round bottles having a wall thickness of 35 mils were charged with various liquids and sealed. The bottles were stored at 73° F. and 50% R.H. and the loss in weight from each bottle over a year's time was measured. The results are summarized in Table IV, below. The low permeability of polyacetal to aromatics and to Freon propellant, together with its high strength and immunity from solvent cracking, make it a first-rate material for aerosol containers.

Miscellaneous properties

Unpigmented acetal resin deteriorates in the presence of ultraviolet light. Even colored compositions, though they retain their properties fairly well, tend to chalk and can be rated only fair in weatherability. For outdoor use, therefore, polyacetal should be protected with a small percentage of high-grade carbon black, well dispersed. Except for UV attack, the resin exhibits excellent resistance to the elements, to soil chemicals, and to fungi, rodents, and insects.

Where it is protected by window glass, polyacetal can be exposed to intermittent sunlight. It should serve satisfactorily, for example, in window hardware or in interior parts for autos.

In contact with a flame or a persistent electric arc, polyacetal burns at about the same rate as polyethylene, polystyrene, acrylics, and cellulose acetate butyrate. However, in those electrical applications where the insulation need not be self-extinguishing, acetal resin offers a powerful combination of good electrical properties, high strength, abrasion resistance, and retention of properties at high temperatures.

Table IV: Permeability of Delrin[a]

Liquid	Delrin — Loss/yr., g.	Delrin — P factor[b]	Regular polyethylene P factor[b]	Linear polyethylene P factor[b]
Methyl salicylate	0.51	0.27	9.1	2.0
Toluene	1.28	0.65	566.0	150.0
Turpentine	0.04	0.023	47.0	3.0
Methanol	—	—	3.6	0.4
Ethanol	0.40	0.22	—	—
Water	7.7	3.5	0.35	—
"Perclene" (chlorinated hydrocarbon)	0.40	0.23	—	—
"Freon" 12/114	0.6	0.33	—	—

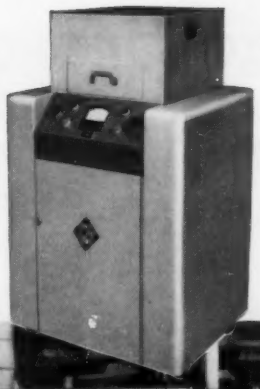
[a]Test conditions:
Containers: sealed 4-oz. Boston Round bottles, blow molded, 35 mils thick.
Temperature: 73° F.
Humidity: 50% R.H.
[b]P-factor is defined as grams lost per 24 hr. per 100 sq. in. area per mil wall thickness. This factor allows the calculation of the loss that can be expected from any given bottle.

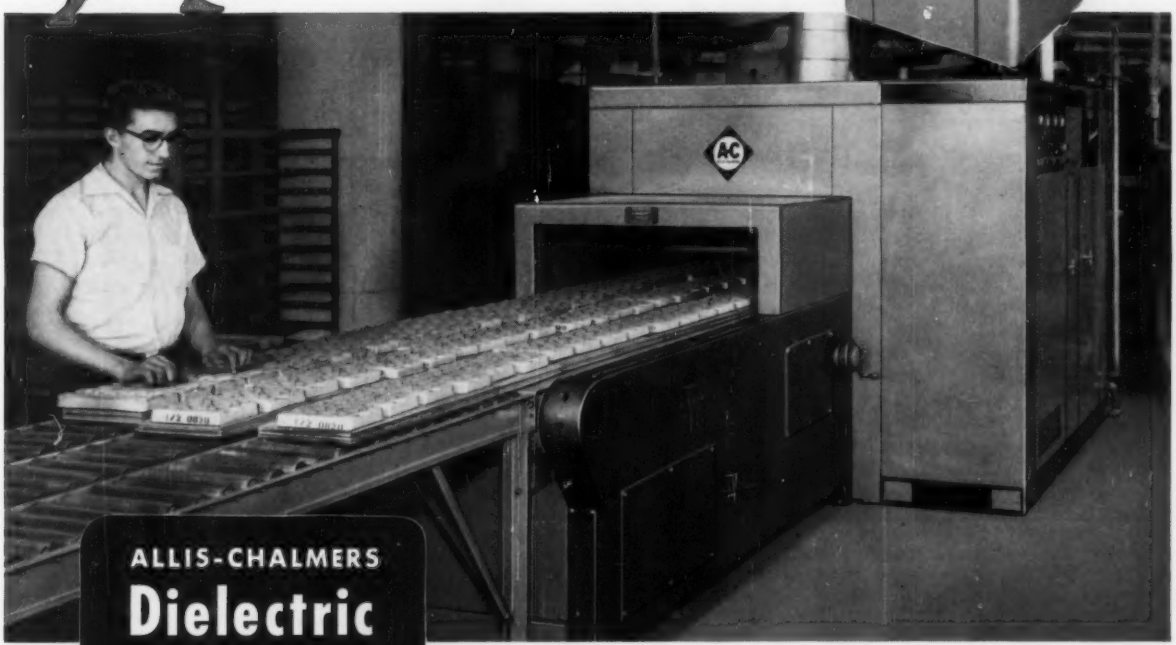
Molding and extrusion

Acetal resin is easily molded in standard injection molding equipment at molding temperatures from 380 to 440° F. Unrestricted gates, generous runners, and high mold temperatures (preferably 250° F.) are recommended for best reproduction of the mold surface finish, particularly in parts of large area. Somewhat higher pressures than are used in molding nylon-6/6 are required. As with most other molding compounds, care must be taken that the resin is not overheated by having cylinders too hot or by allowing it to stand stagnant in stopped hot machines. A cycle delay of 20 min., for example, at

(*To page* 244)

in the laboratory...
on the production line...





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Factors affecting plastisol flow

*By H. E. Frey**

The chief factors affecting the flow characteristics of plastisols are the resin, plasticizers, pigments, and fillers. The resin is of primary importance and its effect on the rheological behavior of the plastisol depends to a great extent on the particle size distribution. Other factors related to the surface may be involved. The flow characteristics are also a function of the history of the compound to some extent; different mixing procedures and conditions will result in somewhat different flow characteristics.

The yield value of plastisols can be estimated from data obtained with a Brookfield viscometer. The flow at high shear stress can be investigated with a Severs-Austin extrusion rheometer. The extrusion rheometer and the Poiseuille equation should not be applied to materials having a high yield value.

Correlations of viscosity data and actual production performance of a plastisol will be mostly empirical because irregularly shaped knives and other variables, e.g., tension, at the coating machine make direct shear stress calculations complicated. Thixotropic breakdown will affect the coating performance of a compound in spreader-coating and roller-coating. A high-speed rotational viscometer is most suitable for studying thixotropic breakdown and recovery.

The factors that affect the flow properties of plastisols, particularly those used for knife-coating and roller-coating of fabrics or other substrates, are discussed in this paper, with particular reference to the flow behavior at high shear stress.

The flow properties of plastisols are of great importance in production practice, especially in high-speed coating operations. A plastisol should have a yield value to prevent the compound from soaking into the textile before and after passing the coating knife. Because the plastisol is subjected to high shear stress while passing the knife, it should have high flow rates at high shear stress. Plastisol flow under high shear stress is also important in the Elastomer vinyl foam process. In rotational casting, only the lower part of the flow curve is of interest.

To predict these characteristics of a plastisol, multipoint viscosity measurements are necessary. The Brookfield (rotating-cup) viscometer is suitable to estimate the yield point, while the Severs-Austin extrusion rheometer allows flow rate measurements at high shear stress.

The application of a capillary-tube-type viscometer, especially at high shear stress, for plastisol viscosity measurements, is not ideal from a theoretical point of view. The Poiseuille equation assumes Newtonian flow and laminar flow. Quite often, however, plastisols are Bingham bodies. There is considerable literature on the limitations of Poiseuille's equation and several corrections have been deduced (1, 2, 3).[1] The Severs-Austin extrusion rheometer was not designed for absolute viscosity measurements, but rather for production control work in the plastisol field. Bearing this in mind, objections that may be justified from a scientific point of view may be disregarded

*Central Research Dept., The General Tire & Rubber Co.

[1]Numbers in parentheses link to references at end of article, p. 252.

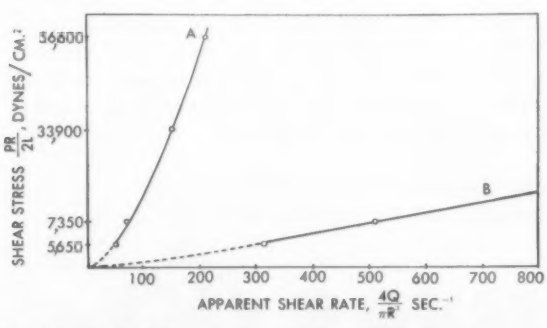


Fig. 1: Typical flow curves of vinyl plastisols. Letter designations in this and following graphs are defined in text

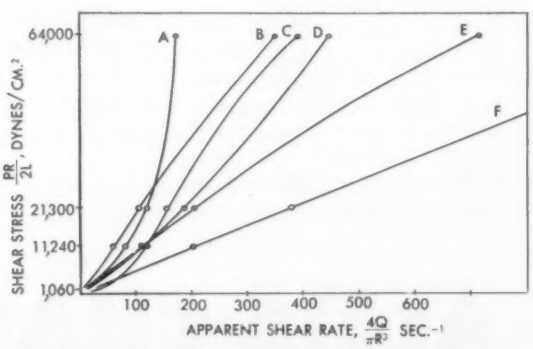
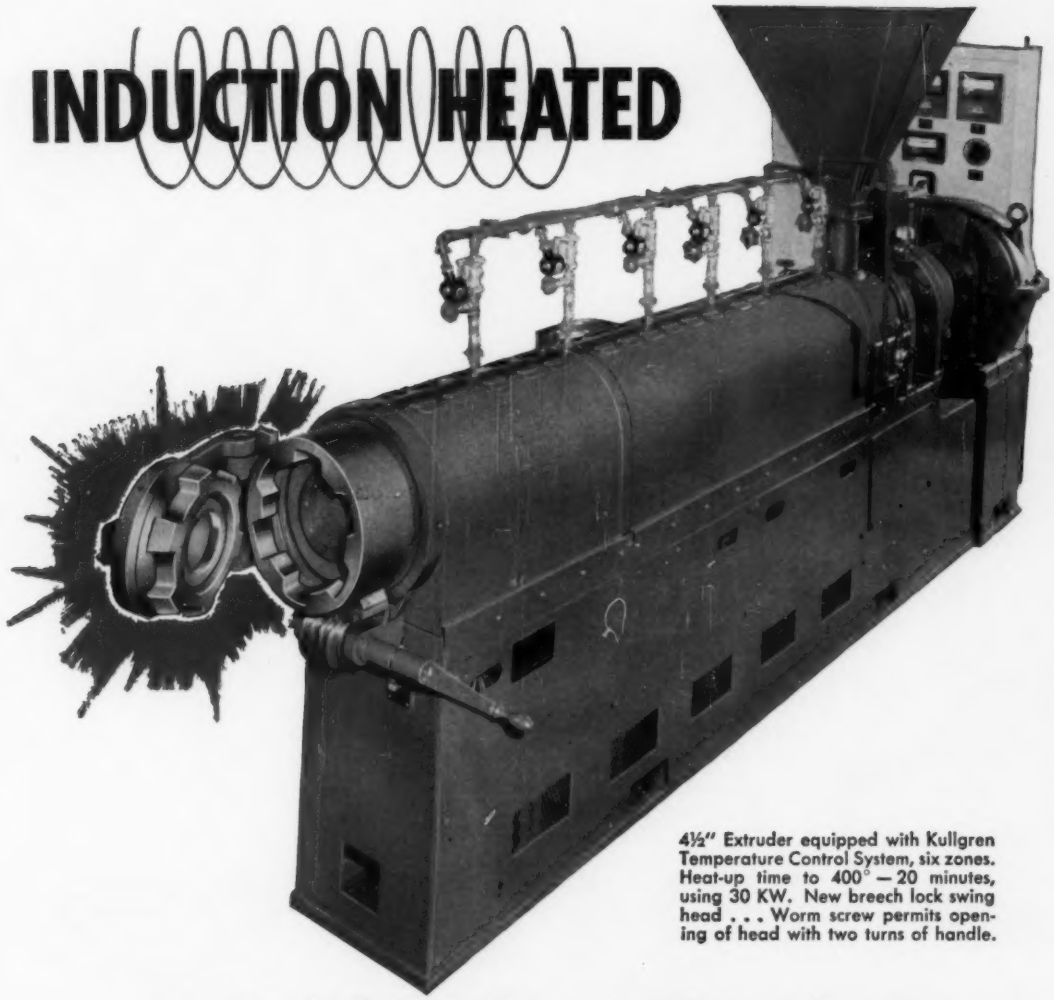


Fig. 2: Effect of resin on plastisol flow: 100 parts resin, 60 DOP; aged 24 hr. at 75° F.

INDUCTION HEATED



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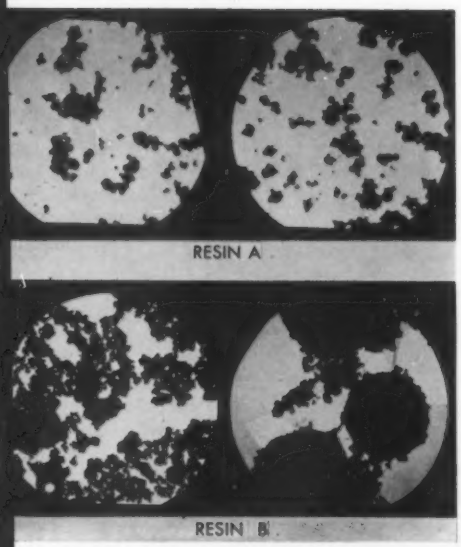

Fig. 3: Photomicrographs of two plastisol resins, 1130X. The two photographs of each resin reflect the average picture obtained by 12 photographs made of each sample

as long as the compounds tested are nearly Newtonian systems.

The Interchemical rotational viscometer has been extensively used for fundamental work on the rheology of non-Newtonian systems (4, 5). This instrument is expensive and is designed for scientific work with high accuracy rather than for production control work.

Both the lower and the upper part of the consistency curve of a plastisol are of importance for high-speed knife-coating. The lower part, allowing an extrapolation of the yield point, has been extensively investigated and compounding aspects have been discussed (6, 7). In this paper, the effect of several compounding ingredients on the consistency curve, especially for the high-shear-stress range, is shown.

Experimental

The techniques of operating the extrusion rheometer and of calculating the results have been described by Severs and Austin (8). Werner (9) has further discussed this method. Using the Poiseuille equation, we have calculated the rates of shear and plotted them against the shear stress. If a concave curve bending towards the stress axis is obtained, the material exhibits dilatency which may cause "knife-spitting" in high-speed coating operations. Compound *A* in Fig. 1, p. 164, caused production difficulties while Compound *B* was very satisfactory. Both compounds gave exactly the same Brookfield viscosities (12,000 cp. at 10 r.p.m.).

Some materials will undergo thixotropic breakdown while passing the orifice of the extrusion rheometer, causing a pressure drop. Thixotropic breakdown and recovery can be determined with a high-speed rotational viscometer but not with the extrusion rheometer. We distinguish between yield and thixotropy according to Green (10)[2]. Basically, a compound showing a straight line relationship between shear stress and rate of shear is desirable. The slope represents the apparent viscosity which should preferably be below 100 units (poises).

Effect of the resin

Flow curves obtained with plastisols based on different resins but containing the same type and amount of plasticizer, are shown in Fig. 2, p. 164. Plastisol *A* is dilatent while plastisol *B* is practically Newtonian.

Electron-microscope photographs (Fig. 3, above) show that resin *A* consists mainly of small spheres while resin *B* also contains some very large spheres to which a number of small particles adhere. Aggregates of that type may rotate freely in the plasticizer if shear stress is applied, while resin *A* will supposedly be deflocculated to a large extent, causing resistance to flow if subjected to shear stress. The plastisol based on resin *E* (Fig. 2) is better than *B* because its "apparent viscosity" is lower. Resin *E* contains a certain portion of relatively large particles. Curve *F* was obtained with a plastisol based on a resin mixture blended so that ideal flow behavior is obtained. Besides better flow characteristics, the resin blend *F* has the following advantages: 1) no volatile solvents have to be added to the compound, allowing 100% solids fixed clearance coating of any desired thickness in one operation; 2) clear base compounds with a lower plasticizer content can be prepared, allowing compounding versatility by simple additions to same base compound.

The viscosity-depressing effect of Geon 202, when mixed in certain proportions with Geon 121, is well-known and may serve as

(*To page* 171)

[2]The Bingham yield value is the minimum tangential shearing force that will just cause flow. Thixotropic materials give hysteresis loops when their up and down curves (as determined with a rotational viscometer) are plotted together.

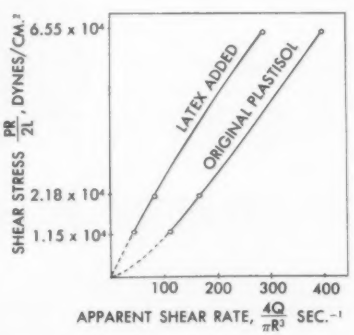

Fig. 4: Effect of latex added to plastisol

Table I: Addition of water to plastisol

Geon 121	100
DOP	60
Water	0, 0.5, 2.5

Resin predried
Moisture found present in resin = 0.3%
Dimensions of orifice: L = 5.00 cm., R = 0.1609 cm.

Pressure	*Efflux*		
	No H_2O	*0.5 H_2O*	*2.5 H_2O*
p.s.i.	*ml./sec.*	*ml./sec.*	*ml./sec.*
0	0.23	0.45	0.44
5	0.97	1.68	1.81
10	1.05	2.02	2.07
30	1.29	2.33	2.83
70	1.75	3.35	4.50

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BAKELITE Phenolic BMM-7000
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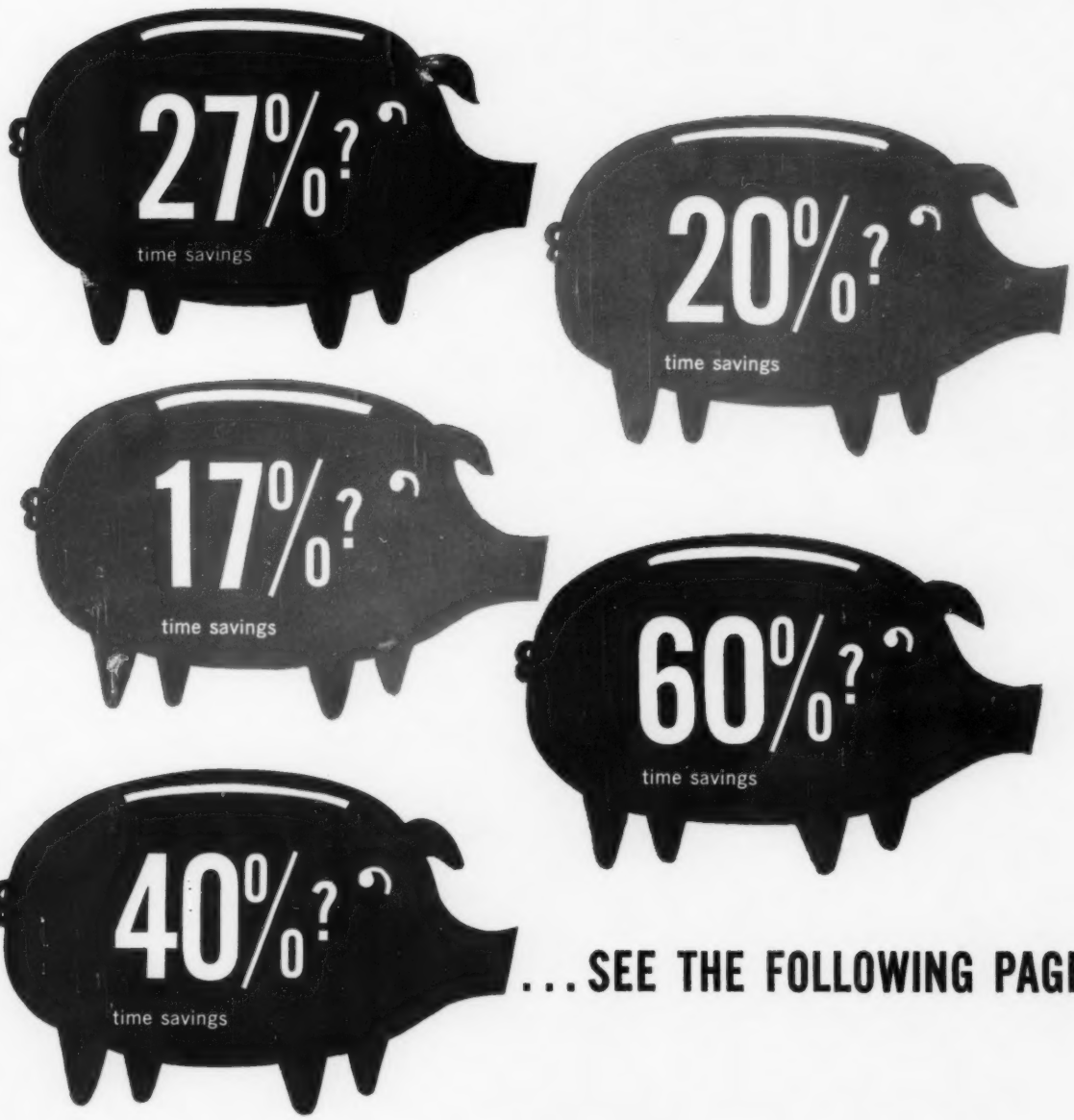

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BMM-7000 is a general-purpose two-step wood-flour-filled phenolic molding material. Its cure speed is exceptional — faster than either two-step or very fast one-step materials. Intended for cold powder automatic molding, BMM-7000 can also be plunger molded on fast cycles.

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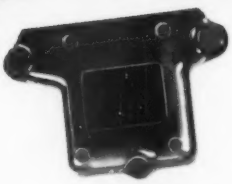
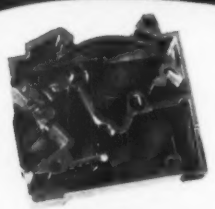
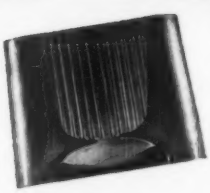


27% less time



20% less time

17% less time



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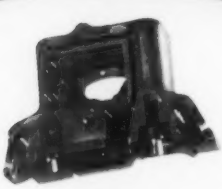
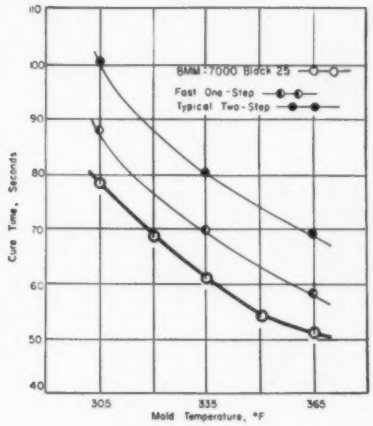
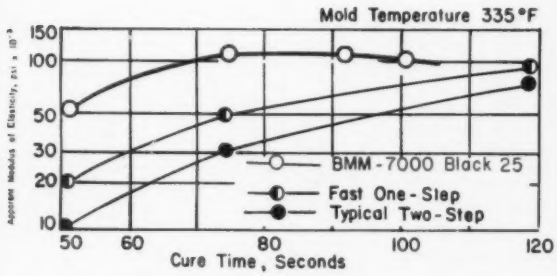


40% less time

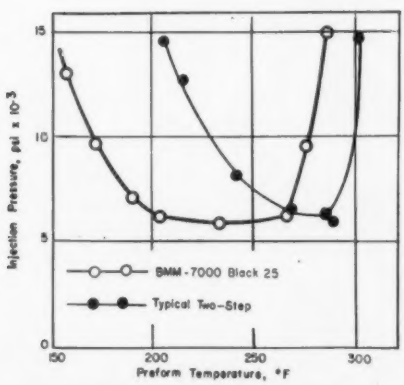
FAST CURE SPEED—BMM-7000 cured as fast at 315 deg. F. as a fast one-step material at 335 deg. F., and a two-step material at 365 deg. F., according to a test of minimum blister-free time in cold powder compression molding.



HOT RIGIDITY—BMM-7000 took 50 seconds to reach an apparent modulus of elasticity of 50,000 psi at 335 deg. F. A fast one-step phenolic took 50 per cent longer, a typical two-step material, 100 per cent longer.



MOLDING LATITUDE—As determined by plunger molding, BMM-7000 could be preheated over a wider range than general-purpose BMG-5000, and still give mold fill-out—an 87 deg. F. spread at 7500 psi, compared to 46 degrees for BMG-5000. This property makes the new material suitable for molding large pieces even with its fast cure speed.



IN ADDITION—BMM-7000 demonstrates good mold release, freedom from mold staining, low specific gravity, and low shrinkage.

TYPICAL TEST VALUES OF BAKELITE BRAND GENERAL-PURPOSE PHENOLIC COMPOUND BMM-7000

BMM-7000 BLACK 25
TYPICAL TEST VALUES

VALUES RELATING TO FABRICATION

Granulation (D392-38)	12 mesh*
Bulk Factor (D392-38)	2.3
Tabletting Qualities	Easily preformed on standard equipment.
Pourability (D392-38), sec.	19
Plasticity Grades Available	6, 9, 12
Molding Shrinkage (D955-51), in./in.	0.004

*All grades supplied in special low fines granulation.

VALUES FROM ELECTRICAL TESTS

Dielectric Strength (D149-55T)			
Short time, volts/mil	330		
Volume Resistivity (D257-54T)			
ohm-cm	6×10^{12}		
	60C	1 KC	1 MC
Dielectric Constant (D150-54T)	6.1	5.7	4.6
Dissipation Factor (D150-54T)	0.08	0.04	0.03

VALUES FROM MISCELLANEOUS TESTS

Molded Specific Gravity (D392-38)	1.36
Heat Distortion Temperature (D648-45T) deg. F.	330
Water Absorption (D570-54T) % wt. gain	0.5

VALUES FROM MECHANICAL TESTS

Izod Impact Strength (D256-54T) (Ft. lb./in. of notch)	0.29
Compressive Strength (D695-54), psi	35,000
Tensile Strength (D651-48) (⅛"), psi	6,900
Flexural Properties (D790-49T):	
Flexural Strength, psi	9,000
Modulus of Elasticity in Flexure, psi	9.5×10^5

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another example of this phenomenon. The effect of the presence of chiefly two different particle sizes in a resin on the viscosity of its plastisols is the subject of a Swiss patent (11). The term viscosity has often been used rather loosely in the past and usually means viscosity at low shear stress. However, a particle size distribution giving a low plastisol viscosity at low shear stress does not necessarily give a low apparent viscosity over a larger shear stress range.

Moreover, in the case of compounds for knife coating, the particle size distribution should be such that a yield value (which is sometimes misinterpreted as high viscosity) and a low plastic (apparent) viscosity over a large shear stress range are obtained at the same time. These important aspects have not previously been pointed out (11, 12).

Koch and Sommer (13) have shown that the particle size distribution of a plastisol resin has a strong effect on plastisol flow. They made their measurements with a rotational viscometer developed by Helmes (14), apparently a very useful instrument for plastisol work. They did not investigate plastisol flow in the high-shear-stress range.

Large particles are likely to cause a somewhat grainy surface upon fusing. In fabric coating this does not matter if the material is heat-embossed after the coating operation.

From a rheological standpoint, the large particles, which obviously help to remove dilatency, do not necessarily have to consist of polyvinyl chloride resin but can consist of water droplets. Figure 4, p. 166, shows how by the addition of a small amount of a latex, dilatency can be removed. Dispersions of this type are of a rather complex nature and reproducibility depends largely on the mixing conditions. Small amounts of latex are added to plastisols in Germany to "thicken" very fluid plastisols (15).

Some moisture as well as surface active materials are usually present in commercial plastisol resins. Small additions of water can result in considerably increased flow rates at high shear stress (Table I, p. 166). Addition of a wetting agent has only little effect on flow rate and surface tension (see Tables II and III). The resin itself, however, is largely responsible for the yield value. Figure 5, right, shows Brookfield consistency curves of the same plastisols on which Fig. 2 is based. Resin *B* gives a plastisol with a high yield value which is desirable in knife-coating.

There are other factors re-

Table II: Addition of wetting agent to plastisol

Geon 121	100	DIDA	30
Santicizer 141	45	Triton X-100	0, 0.5, 2.5

Dimensions of orifice: L = 5.00 cm., R = 0.1609 cm.

Pressure	*Efflux*		
	0[a]	*0.5*[a]	*2.5*[a]
p.s.i.	*ml./sec.*	*ml./sec.*	*ml./sec.*
0	0.16	0.16	0.20
10	2.36	2.53	2.84
30	6.30	6.40	7.65
50	10.20	10.80	12.25
80	17.20	18.40	21.5

[a]Parts of Triton X-100

Table III: Effect of wetting agent on surface tension

Surface tension 78°F.
Compound as in Table II

	No wetting agent	*0.5*	*2.5*
Surface tension, dynes/cm.	35.6	35.2	34.9

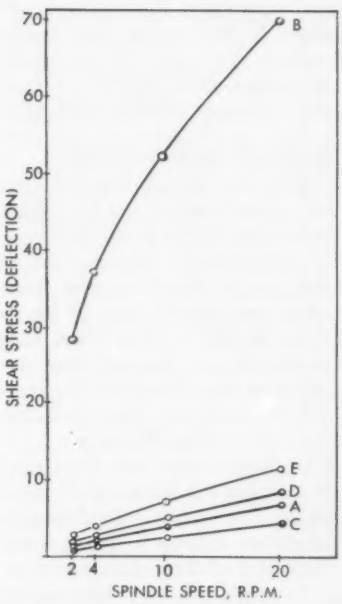

Fig. 5: Brookfield consistency curves of plastisols

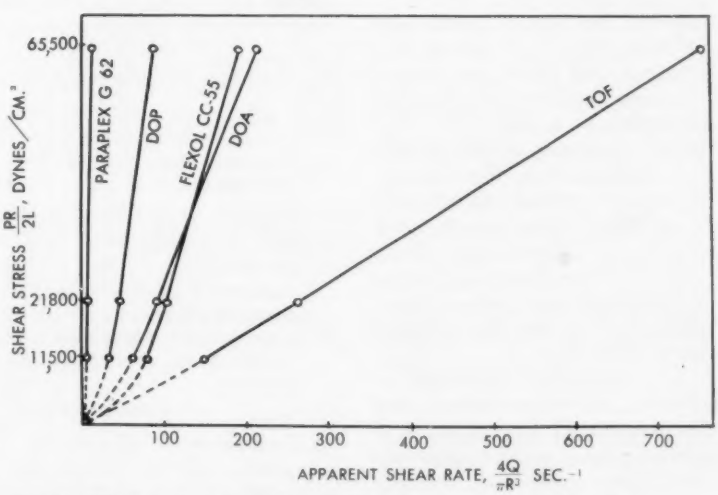

Fig. 6: Effect of plasticizer. Compounds made up of 100 parts resin, 60 parts plasticizer; aged 24 hr. at 75° F.

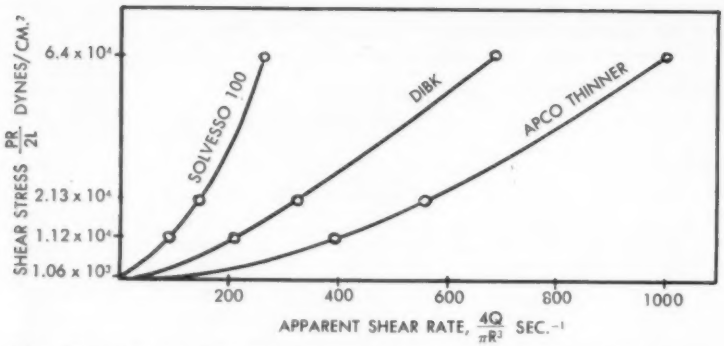

Fig. 7: Effect of diluents. Compound (parts by weight): Geon resin 121—100, DOP—10, solvent—10

lated to the history of a resin, such as the spray drying conditions used, that can have a noticeable effect on plastisol flow (16).

Effect of the plasticizer

It is well known that plasticizers greatly affect the flow characteristics of plastisols. Figure 6, p. 171, shows flow curves of compounds based on the same resin and tested after 24 hr. of aging at 75° F. The effect of a plasticizer on plastisol flow depends on the viscosity of the plasticizer and on its solvating strength towards the resin.

Organic diluents are often used to depress the viscosity of plastisols. The choice of the diluent is important. Figure 7, above, shows the effect of three different diluents. Although the viscosity is depressed, dilatency is not removed.

Effect of pigments

From the field of paints and printing inks, it is known that pigments and fillers can have a considerable effect on the flow properties of a compound. This effect is governed by the particle size and shape of the pigment, the ease of wetting (surface tension) and, consequently, the degree of deflocculation. Thus, phthalocyanine blue will produce a compound with a flow curve different from one that contains ultramarine blue.

It is a common experience in plastisol spreader-coating that "knife-spitting" may occur with certain colors, while compounds with other colors run smoothly at high speeds. Figure 8, above, shows flow curves of plastisols, each containing the same volume loading of different pigments (five volumes per 100 parts by weight of PVC and 50 parts by weight of plasticizer), which have been added in the form of pigment-plasticizer dispersions. Figure 9 shows the corresponding Brookfield consistency curves; the yield values vary considerably.

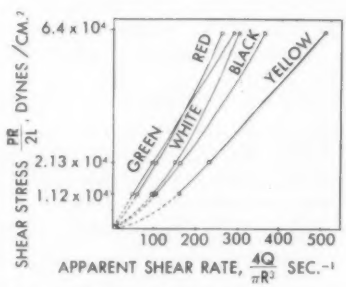

Fig. 8: Effect of pigments

The effect of pigments on plastisol flow can be corrected to a certain extent by compounding. Preparation of the pigment grinds in a proper way is important. The viscosity and wetting power of the grinding medium will affect both color development and flow behavior. Pigments with plate structure form gels, sometimes resulting in considerable yield values. The yield value can be depressed by the addition of more wetting agent or other substances (17, 18) and of a filler that produces no yield value. The yield value can be extrapolated from a consistency curve obtained with a Brookfield viscometer and calculated by using simple equations (19). For building up a certain yield value, which is desirable in fabric knife-coating, various means exist. For example, a filler having plate structure like silica gel or bentonite can be added. Another way is to heat the plastisol for a short time. This increases the yield point but affects the upper part of the consistency curve disadvantageously (Table IV, below.)

Acknowledgement

We are obliged to J. W. McCamont, who did the electron microscopical evaluation, part of

(*To page 252*)

Table IV: Effect of heating the plastisol

Compound: Geon 121 100, DOP 70

1) *Brookfield RVF viscosities (#6 spindle), deflection (torque)*

Treatment	*Spindle speed, r.p.m.* 2	4	10	20
Unheated, 2 hr. after mixing	1.5	2.5	4.75	8.5
Heated, kept at 50°C. for 30 min. under stirring, then cooled to room temperature	2.75	4.5	9.5	16.5

2) *Severs-Austin extrusion rheometer data (Dimensions of orifice: L = 5.00 cm., R = 0.3081 cm.)*

Pressure	*Heated plastisol*	*Unheated plastisol*
p.s.i.	*ml./sec.*	*ml./sec.*
5.3	3.88	4.15
10	5.66	8.91
30	12.3	15.0
70	27.5	40.2

Acrylonitrile-acrylate copolymers for wire insulation

By Joseph Rosenberg and Harold L. Greenberg*†*

Various acrylonitrile-acrylate copolymers were prepared and tested for electrical and mechanical properties. The range of properties obtainable with these materials, together with inherent thermal and moisture resistance, indicates that useful thermoplastics exist in this series.

Like so many other materials that were little more than laboratory curiosities or too high-priced for general use, acrylonitrile-acrylate copolymers are now available for more widespread manufacture and use because of recent raw material developments. This family of polymers provides a fertile field for those interested in "tailor-made" materials.

Discovered in 1893, it was not until the late 1930's that large-scale production made acrylonitrile readily available. A very similar situation prevailed with acrylate esters. In recent years, the higher acrylate esters have become available in increasing profusion and with more attractive prices.

Polymers belonging to this family of materials have also become more available. For the most part, they are useful only when vulcanized or cured in some manner. Past work indicated that, at the very least, materials with good thermal stability could be obtained; and a program undertaking the preparation and evaluation of a wide range of copolymers from the viewpoint of thermoplastics was initiated. Some polymers were custom-made for us, while the remainder were made in our own laboratory.

Monomers

Methyl, ethyl, *n*-butyl, 2-ethylhexyl, and *n*-octyl acrylates, and lauryl and stearyl methacrylates were obtained from the Rohm and Haas Co., and *n*-decyl and *n*-lauryl acrylates from Monomer-Polymer Div. of The Borden Co.

The higher *n*-alkyl acrylates, such as cetyl and stearyl, were prepared by alcoholysis. The procedure consisted of refluxing methyl acrylate with the higher alcohol, in the presence of toluenesulfonic acid, and distilling methanol-methyl acrylate azeotropically (b.p. 62 to 63° C.) as it was formed. The acrylate was vacuum-distilled and then purified by redistillation. References for the preparation of the acrylates are listed (1—4).[1]

The removal of the hydroquinone inhibitor from the acrylates was accomplished by washing with 5% sodium hydroxide solution. Three washings with this solution were sufficient to remove the inhibitor. Following these washings the acrylate was washed with distilled water several times, with a 1% sulfuric acid solution three times, and finally with distilled water until the aqueous layer was no longer acid after agitation with the monomer.

The acrylonitrile was purified by distillation at atmospheric pressure.

Polymerization

The data for the preparation and milling of the copolymers are listed in Table I, p. 174. Potassium persulfate was the catalyst used for reactions involving the lower-boiling acrylates. Reactions with decyl, lauryl, cetyl, and stearyl acrylates and the methacrylates required benzoyl peroxide for initiation of the reaction. The emulsion technique was used to polymerize the short alkyl acrylates. The suspension technique was used primarily to prepare copolymers of decyl and the longer chain acrylates and methacrylates. Triton 770 was the emulsifying agent and lauryl mercaptan the chain stopper. The mercaptan was excluded from the reactions that involved the longer chain acrylates when too much inhibition was found. The reactions between acrylonitrile and higher-boiling acrylates such as decyl, lauryl, cetyl, and stearyl acrylates, and methacrylates, initiated by potassium persulfate, produced low-molecular-weight copolymers and very poor yields.

A water bath in which the bottles rotated at 60 r.p.m. was used for emulsion polymerizations. The bottles were of 1000- or 2000-ml. capacity, fitted with metal caps having a lining of butyl rubber covered with aluminum foil. These bottles were charged as prescribed for the reaction, and then placed in the water bath at 80° C.

After the completion of the polymerization the residual monomer was removed by steam distillation. This distillation of the latex mixture was continued until the upper layer (monomer) of the distillate ceased to increase further.

The latex was precipitated in a 5% sodium chloride solution. The

[1]Numbers in parentheses link to references at end of article, p. 256.

*General Electric Co., Direct Current Motor and Generator Dept.
†Present address: Aerojet-General Corp., Azusa, Calif.

Table I: Summary of polymer preparations

Comonomer	Sample No.	Acrylonitrile		Water	Acrylate	Acrylonitrile	Catalyst[a]	Lauryl mercaptan	Triton 770 conc.	Reaction time	Temp.	Conversion	Method[b]	Mill Temp.
		Weight %	Mole %	ml.	g.	g.	g.	g.	g.	hr.	°C.	%		°C.
Ethyl acrylate	41C	15.6	25.9	250	76	15	0.1	0.1	3.0	5	Reflux	76.8	E	120
	41F	23.1	36.2	337	69	25	0.1	0.1	0.1		Reflux	67.0	E	140
	41H	25.1	38.7	250	72	25	0.1	0.1	4.0	5	Reflux	75.4	E	140
	41I	32.4	47.5	250	62	35	0.1	0.1	4.0	5	Reflux	80.8	E	170
	41K	42.4	58.1	250	53	45	0.1	0.1	4.0	5	Reflux	78.2	E	160
n-Butyl acrylate	43A	56.3	75.5	200	40	60	0.1	0.1	3.0	3	Reflux	97.0	E	140
	43B	36.5	57.9	200	60	40	0.1	0.1	3.0	3	Reflux	80.9	E	140
	43C	46.8	67.9	200	45	55	0.1	0.1	3.0	3	Reflux	94.8	E	140
	43H	43.1	63.7	200	55	50	0.1	0.1	3.0	3	Reflux	92.3	E	150
	43I	39.2	61.5	250	67	50	0.1	0.1	3.0	5	Reflux	90.1	E	150
n-Hexyl acrylate	45A	41.7	67.8		50	50	Prepared by Monomer-Polymer						S	110
	45B	52.2	73.7	400	40	60	0.1	0.1	4.0	15	80	66.0	E	155
	45D	64.9	84.5	400	30	70	0.1	0.1	4.0	15	80	68.5	E	155
	45E	75.9	90.3	400	20	80	0.1	0.1	4.0	15	80	67.7	E	165
Cyclohexyl 2-ethylbutyl acrylate	46A	56.8	79.2		50	50	Prepared by Monomer-Polymer						S	110
	47A	46.2	71.6		50	50	Prepared by Monomer-Polymer						S	
	47B	53.4	77.1	400	60	40	0.1	0.1	4.0	15	80	82.2	E	110
	47C	63.0	83.4	400	65	35	0.1	0.1	4.0	15	80	79.2	E	150
	47D	66.4	85.3	400	70	30	0.1	0.1	4.0	15	80	81.0	E	150
	47E	76.9	90.7	400	80	20	0.1	0.1	4.0	15	80	84.0	E	170
2-Ethylhexyl acrylate	48A	45.4	73.8		50	50	Prepared by Monomer-Polymer						S	110
	48B	54.9	80.9	400	40	60	0.1	0.1	4.0	15	80	81.8	E	170
	48C	77.5	92.2	400	20	80	0.1	0.1	4.0	15	80	84.3	E	[c]
n-Octyl acrylate	49A	44.8	73.8		50	50	Prepared by Monomer-Polymer						S	120
	49B	57.5	82.4	400	40	60	0.1	0.1	4.0	15	80	84.0	E	120
	49C	77.9	92.4	400	20	80	0.1	0.1	4.0	15	80	92.4	E	[c]
	49D	68.2	88.2	400	30	70	0.1	0.1	4.0	15	80	84.0	E	[c]
n-Decyl acrylate	50A	50.2	86.7		50	50	Prepared by Monomer-Polymer						S	130
	50B	64.0	87.9	400	40	60	0.4	None	6 drops	3	Reflux	88.0	S	160
	50C	86.0	92.5	400	20	80	0.1	None	4.0	15	80	73.8	E	[c]
Lauryl acrylate	51A	45.6	79.0	400	50	50	0.3	None	6 drops	3	Reflux	81.5	S	150
	51C	59.1	86.6	400	30	70	0.3	None	2.0	2½	Reflux	73.0	S	[c]
Cetyl acrylate	51D	52.5	83.2	400	40	60	0.3	None	2.0	2	Reflux	82.2	S	160
	53A	52.8	86.2	400	50	50	0.6	None	1.0	3	Reflux	83.0	S	170
	53B	57.2	87.8	400	40	60	0.6	None	1.0	3	Reflux	81.4	S	170
	53D	76.2	94.7	400	20	80	0.1	0.1	4.0	15	80	Poor reaction	E	[c]
Ethyl methacrylate	44A	58.3	75.0		50	50	Prepared by Monomer-Polymer						S	110
Lauryl methacrylate	55A	48.8	62.2	400	50	50	ca. 0.3	None	1.0	3	Reflux	83.6	S	85
	55B	49.7	82.5	400	40	60	ca. 0.3	None	1.0	3	Reflux	73.2	S	110
	55C	54.5	85.2	400	30	70	ca. 0.3	None	1.0	3	Reflux	65.6	S	110
Stearyl methacrylate	56A	41.7	82.2	400	50	50	ca. 0.3	None	1.0	3	Reflux	Poor	S	90
	56B	55.6	89.0	400	40	60	ca. 0.8	None	1.0	3	Reflux	Poor	S	130
	56C	62.3	91.4	400	30	70	ca. 0.8	None	1.0	3	Reflux	Poor	S	150

[a] The catalyst for ethyl through *n*-octyl acrylate systems was potassium persulfate; for the remaining systems the catalyst was benzoyl peroxide.
[b] E = emulsion; S = suspension
[c] Could not be milled

temperature of the precipitating medium was found to be important. A high solution temperature precipitated out the material in large pieces. These pieces of material were difficult to cut and to wash thoroughly. A low solution temperature precipitated too fine a material which was difficult to handle in filtration and washing operations.

In general, the lower acrylate copolymers, such as butyl, required an iced solution while the higher ones, such as 2-ethylhexyl, required a solution at room temperature or higher. This temperature depended upon the amount and temperature of the latex to be precipitated. Thorough stirring was necessary for a good precipitate. The copolymer was then washed free of chloride. The initial drying of the product was performed at room temperature under vacuum until the bulk of the water had evaporated. Next

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Table II: Extrusion conditions

Sample No.	Head temp.	Barrel temp.	Wire preheat	Screw speed	Wire take-up speed
	°C.	°C.	°C.	r.p.m.	ft./min.
43I	200	150	450	43	About 18
50A	220	180	500	43	About 18
48A	200	175	600	43	About 27

the material was dried to constant weight in a vacuum oven at a temperature of 75° C.

An example of emulsion polymerization in a sealed vessel: The following charge was placed in a 1000-ml. bottle:

2-Ethylhexyl acrylate (inhibitor free)	40.0 g.
Acrylonitrile (inhibitor free)	60.0 g.
Triton 770	4.0 g.
Potassium persulfate	0.1 g.
Lauryl mercaptan	0.1 g.
Distilled water	400.0 ml.

The catalyst was added last. The bottle was shaken briefly and then placed on the rotating rack in the water bath at 80° C. for 15 hours. The reaction mixture was steam distilled and then precipitated in 2 l. of 5% sodium chloride solution. The precipitate was washed free of chloride ion and then dried.

An example of emulsion polymerization in an open vessel: A 12-l. glass reaction flask fitted with a four-joint top was set in a steam bath and the following charge added:

2-Ethylhexyl acrylate (inhibitor free)	600 g.	(555 ml.)
Acrylonitrile (inhibitor free)	900 g.	(1135 ml.)
Distilled water	6000 ml.	
Lauryl mercaptan	1.5 g.	
Potassium persulfate	1.5 g.	

The flask was equipped with a thermometer, propeller-type stirrer of stainless steel, and four 400-mm. water-cooled condensers

Table III: Physical properties of copolymers

Sample No.	Mechanical properties	D.-C. resistivity				Power factor			
		25°C.	50°C.	75°C.	100°C.	25°C.	50°C.	75°C.	100°C.
		ohm-cm.	ohm-cm.	ohm-cm.	ohm-cm.	%	%	%	%
41C	Flexible, rubbery	4.4×10^{12}	3.5×10^{11}	1.9×10^{11}	5.0×10^{10}	14.3	65.2	>99	
41F	Soft, flexible	2.8×10^{13}	5.5×10^{11}	4.6×10^{10}	2.5×10^{9}				
41H	Soft, flexible	5.2×10^{10}	1.6×10^{10}	1.6×10^{9}	1.5×10^{9}	22.7	32.2	93	97
41I	Hard, flexible	4.5×10^{13}	1.5×10^{11}	5.0×10^{9}	1.4×10^{9}				
41K	Hard, rigid, brittle	1.1×10^{15}	4.5×10^{14}	1.5×10^{13}	1.4×10^{10}	2.8	11.5	20.0	54.0
43A	Hard, flexible	7.9×10^{15}	1.2×10^{13}	3.1×10^{10}	6.7×10^{9}	2.8	8.7	24.7	
43B	Hard, flexible	4.5×10^{13}	3.4×10^{10}	8.0×10^{9}	—	15.2	22.8	78.3	
43C	Hard, flexible, horny	2.7×10^{14}	6.3×10^{12}	5.4×10^{10}	1.0×10^{10}	5.5	17.3	23.0	83
43H	Hard, flexible	2.9×10^{13}	1.6×10^{12}	8.5×10^{9}	1.6×10^{9}	16.6	22.7	56.0	92
43I	Hard, flexible	8.1×10^{13}	4.1×10^{11}	4.3×10^{9}	4.3×10^{8}	6.2	23.0	46.0	98
45A	Hard, flexible	4.9×10^{13}	1.9×10^{12}	1.8×10^{11}	3.6×10^{10}	12.7	10.5	10.8	27.0
45B	Horny, slightly brittle	3.3×10^{14}	1.3×10^{11}	2.0×10^{10}	1.2×10^{10}	4.1	14.0	31.0	93
45D	Brittle	1.3×10^{15}	1.5×10^{14}	5.0×10^{11}	1.2×10^{10}	3.7	6.4	17.0	30.0
45E	Very brittle	1.6×10^{15}	4.8×10^{14}	9.3×10^{12}	1.0×10^{11}	5.0	6.7	13.0	20.0
46A	Hard, very brittle	7.4×10^{15}	3.8×10^{15}	2.8×10^{14}	5.3×10^{12}	2.1	23.0	6.2	18.0
47A	Hard, rigid	1.9×10^{14}	1.2×10^{12}	2.0×10^{10}	1.4×10^{9}	12.0	13.0	92	14.0
47B	Hard, slightly brittle	$>1.6\times10^{15}$	1.1×10^{14}	2.2×10^{11}	5.1×10^{9}	3.0	6.7	22.0	53.0
47C	Hard, slightly brittle	$>1.0\times10^{15}$	4.2×10^{14}	9.0×10^{12}	2.5×10^{10}	3.3	6.9	15.0	23.0
47D	Hard, brittle	1.2×10^{15}	5.0×10^{14}	4.2×10^{12}	3.8×10^{10}	3.4	5.4	14.0	20.0
47E	Hard, brittle	1.2×10^{15}	9.0×10^{14}	3.9×10^{13}	5.0×10^{11}	4.9	6.9	11.0	19.0
48A	Hard, flexible	1.3×10^{14}	2.0×10^{13}	1.2×10^{12}	1.5×10^{11}	10.6	9.9	7.9	10.6
48B	Horny, slightly brittle	5.0×10^{14}	1.6×10^{13}	1.9×10^{10}	2.2×10^{9}	3.5	10.5	3.6	75.0
49A	Hard, flexible	1.1×10^{14}	3.4×10^{12}	1.6×10^{11}	1.4×10^{11}	8.6	9.5	8.3	13.0
49B	Hard, flexible	9.4×10^{14}	2.9×10^{11}	4.7×10^{9}	3.3×10^{9}	6.7	15.5	36.0	65.0
50A	Hard, flexible	1.6×10^{13}	3.0×10^{13}	1.5×10^{10}	1.9×10^{9}	7.3	9.5	8.3	9.2
50B	Slightly brittle	1.0×10^{15}	1.9×10^{14}	1.7×10^{13}	2.2×10^{12}	4.7	9.5	12.0	11.0
51A	Flexible, cheesy	1.0×10^{13}	4.8×10^{11}	1.7×10^{11}	7.5×10^{10}	5.0	9.7	13.0	22.0
51D	Flexible, cheesy	3.0×10^{14}	6.5×10^{11}	2.1×10^{10}	1.6×10^{9}	4.8	10.5	41.0	87.0
53A	Flexible, cheesy	1.0×10^{13}	2.1×10^{13}	7.8×10^{11}	9.0×10^{10}	3.0	5.9	8.3	16.0
53B	Flexible, cheesy	1.2×10^{15}	3.7×10^{13}	1.9×10^{12}	1.4×10^{11}	3.9	6.0	8.7	11.8
55A	Flexible, cheesy	1.4×10^{14}	5.8×10^{12}	4.2×10^{11}	7.2×10^{10}	7.3	6.5	8.3	22.0
55B	Flexible, cheesy	3.1×10^{14}	3.1×10^{13}	1.1×10^{12}	1.2×10^{11}	5.2	8.6	8.4	20.0
55C	Flexible, cheesy	5.0×10^{14}	7.2×10^{13}	2.2×10^{12}	2.1×10^{11}	4.6	9.0	8.6	18.0
56A	Flexible, cheesy	5.6×10^{14}	9.0×10^{13}	3.8×10^{11}	6.1×10^{10}	3.4	5.3	8.2	22.0
56B	Flexible, cheesy	8.3×10^{14}	5.9×10^{13}	2.1×10^{11}	9.5×10^{10}	4.2	6.9	8.4	16.0
56C	Brittle	1.3×10^{15}	2.3×10^{13}	8.9×10^{11}	10.5×10^{10}	4.3	6.4	9.3	13.0

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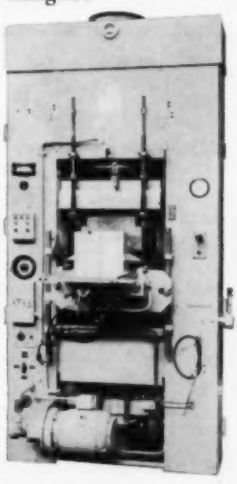

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(two in a joint). Stirring was constant and vigorous. The mixture was heated with utmost caution until the first sign of the vigorous reaction was observed. The heat input was then decreased and the reaction allowed to go on under its own heat of reaction. After this initial reaction subsided the heat input was once more cautiously raised and the reaction continued to completion. The latex was steam-distilled and then precipitated by pouring it into 20 l. of 5% sodium chloride solution contained in a stainless steel vessel. The precipitate was washed free of chloride ion and dried to constant weight. Yield was about 83 percent.

An example of suspension polymerization: Forty grams of *n*-decyl acrylate, 60 g. of acrylonitrile, six drops of Triton 770, and 400 ml. of distilled water were placed in the lower section of a 500-ml. reaction flask. The top section, equipped with a stainless steel propeller-type stirrer, reflux condenser, and thermometer, was clamped into position. The mixture was heated by steam and was constantly stirred. At 70° C. refluxing began. The benzoyl peroxide was then added in small quantities through the condenser opening until polymerization was initiated. The initiation of the reaction was noted by a rise in reaction temperature to above 80° C. The major portion of the reaction was completed in the first 0.5 hr. of the 2 to 3 hr. required to complete the reaction. The mixture was steam-distilled, filtered, washed, and dried in a vacuum oven to constant weight. The yield was 88 percent.

Milling and molding

The copolymers were milled at their respective temperatures on a Farrel-Birmingham laboratory mill. The roll temperatures ranged from 110 to 170° C. They were obtained by trial and error and are listed in Table I. Wool grease was found to be the most suitable lubricant. This lubricant was added in very small amounts until the material no longer stuck to the rolls.

Specimens of 4-in. diameter and 15- to 20-mil thickness were used for the electrical tests. The best specimens were obtained when 4-in. disks were cut from a sheet of 25-mil thickness, placed in the mold and formed at 150° C. and 3000 p.s.i. pressure. In some cases it was found advantageous to wipe the inner lining of the mold with a very thin layer of wool grease in order to prevent sticking.

Extrusion

Temperature control was of the utmost importance in the extrusion. The initial extrusion temperature for each material was estimated from the milling temperature. The final extrusion temperature was obtained by trial and error. In general, it was found that the extrusion temperature was 30 to 40 degrees above the mill temperature. Furthermore, a difference of 20 to 30 degrees between the higher head temperature and the lower barrel temperature helped to give good flow.

The extruder was a National Rubber Machinery Co. 1-in. bench model. A single, full-flighted, chrome-plated screw with a pointed end was used. The temperature of the barrel was controlled through the use of a Wheelco Model #292 electronic pyrometer contained in the unit. An Alnor Pyrocon hand-type surface-contact pyrometer was used to take temperature readings of the head, since this had no built-in temperature control. The die temperature was assumed to be the same as the head temperature.

The wire was preheated by a single-unit, hinged-type furnace. This furnace was regulated by a variable transformer and the temperature read by a Hoskins Portable Pyrometer. A crosshead die with pin was used. The die had a hole 42 mils in diameter; the diameter of the pin was 24 mils.

Draw-down, roughness, and off-centering were eliminated by synchronizing the wire take-up speed with the material flow through the die. Drying of the copolymer and preheating of the core before extrusion helped to eliminate bubbles. The drying time was 1 hr. or more. Drying temperature for 43I was 50° C.; for 48A and 50A, 70 to 100° C.

The physical appearance and the color of the extruded wire gave good indications of whether the material was extruded properly. When the temperature was extremely low the material extruded was fibrous in character and could be pulled apart easily. Too low temperature, but nearer the proper extrusion temperature, produced a striated effect on the surface of the resin. A more obvious effect was the appearance of lumps when the temperature was insufficient to soften the material. A high temperature, but fairly close to the extrusion temperature, gave a high gloss to the polymer. At too high a temperature irregular flow lines were noted to appear.

Each polymer reached a maximum flow at a given temperature, and any further rise in temperature did not increase flow; instead

(*To page* 253)

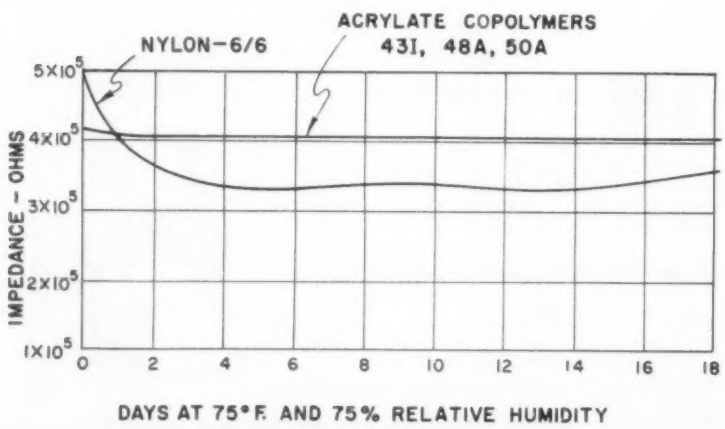

Fig. 1: Comparison of effect of moisture on acrylonitrile copolymers and on nylon-6/6

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Reinforced plastics conference

Program of the 13th annual session, to be held Feb. 4, 5, and 6, 1958, at the Edgewater Beach Hotel, Chicago, Ill.

On Feb. 3, 1958, at 12 o'clock noon, registration for the 13th Annual Conference of the S.P.I. Reinforced Plastics Div. will begin at the Edgewater Beach Hotel, Chicago, Ill. It will continue on Feb. 4, 5, and 6 at 7:30 A.M. Speakers' breakfasts will be held at 7:30 A.M. on Feb. 4, 5, and 6 and the exhibit will open at 8:30 A.M. of the 4th. Program of the sessions will be as follows:

Tuesday, Feb. 4

9:30 A.M. to 12:00 noon—Three concurrent sessions on Materials Survey, Strength-Time Behavior of Reinforced Plastics (Materials and Laminates), and Quality Control.

Session I—Materials Survey

Presiding: Thomas J. Jordan, General Electric Co. Vice Chairman: H. K. Phinney, Bakelite Co., Div. Union Carbide Corp.

"Survey—Resin Developments," Dr. Johan Bjorksten, Bjorksten Research Laboratories, Inc.

"Evaluation of Commercial Organic Peroxides on the Basis of Half-Life Data," Donald F. Doehnert and Dr. Orville L. Mageli, Lucidol Div., Wallace & Tiernan, Inc.

"Functional Inorganics for Use as Reinforced Plastic Fillers," S. R. Mountsier, Jr., and Miss A. J. Gitter, Whittaker, Clark & Daniels, Inc.

"Properties of Reinforced Plastics Made from Acrylic Sirup," Mandell S. Ziegler, William H. Calkins, and Walter M. Edwards, E. I. du Pont de Nemours & Co., Inc., Polychemicals Dept.

"Optimum High - Strength Epoxy Laminates," Harry Raech, Jr., Northrup Aircraft, Inc., and Fred Harris, Grand Central Rocket Co.

Authors' Panel Discussion

Session II—Strength-Time Behavior of Reinforced Plastics (Materials and Laminates)

Presiding: Dr. H. R. Nara, Case Inst. of Tech. Vice Chairman: T. B. Blevins, Dept. of the Army, Off. of the Chief of Ordnance.

"Effect of Curing Conditions on Physical Properties," Grant Brown, Cordo Chemical Corp.

"Determination of Cure State in Reinforced Plastics by Dielectric Measurements," John J. Knudsen, Delsen Corp.

"Improvement of Reinforced Plastics by Fibers from New Glasses," James W. Case, Dept. of the Navy, Bureau of Ordnance; Dr. Albert Lasday and J. Frees Brassy, Houze Glass Corp.

"Mechanical Properties of Glass Reinforced Casting Resins," C. L. Segal, Hughes Aircraft Co.

"Glass Fabric-Base Laminate Physical Properties as a Function of Finishing Variables," by Richard C. Horton and Henry S. Falls, J. P. Stevens & Co., Inc.

Authors' Panel Discussion

By title only: *"Tensile Strength of Glass Fibers,"* J. A. Kies, Ballistics Branch, Naval Research Lab. *"An Investigation of the Optical Properties of Fiberglass Reinforced Translucent Panels,"* John B. Crenshaw and Daniel Smith, Interchemical Corp.

Session III—Quality Control

Presiding: A. E. Raeuber, Southern Research Institute. Vice Chairman: C. H. Rybolt, Lucidol Div., Wallace & Tiernan, Inc.

"'Controlled Process' Fabrics from Controlled Weight-Length Variation Yarns," William J. Eakins, DeBell & Richardson, Inc.

"Bond of Resin to Glass," A. C. Anderson and Dr. J. H. Healy, A. O. Smith Corp.

"Proposed NOL Ring Test Method for Parallel Glass Roving Reinforced Plastics: Evaluation of Chemical Finishes," Porter W. Erickson, Irving Silver, and H. A. Perry, Jr., U. S. Naval Ordnance Laboratory, White Oak, Silver Spring, Md.

"Quality Control for Glass Fiber Reinforced Translucent Panels," George R. Huisman, Filon Plastics Corp.

"Reliable Properties Can Be Guaranteed Despite Many Cantankerous Variables," Roger S. Jackson, The Glastic Corp.

Authors' Panel Discussion

12:30 to 2:00 P.M., Luncheon. Welcoming Address and Presiding: G. L. Smead, L-O-F Glass Fibers Co. *"What the Reinforced Plastics Industry Needs,"* R. S. Morrison, Molded Fiber Glass Co. *"The Meaning of ISO Activity to the Reinforced Plastics Industry,"* Dr. G. M. Kline, National Bureau of Standards.

2:00 to 5:00 P.M. Three concurrent sessions on Strength-Time Behavior of Reinforced Plastics (Test Methods and Fibers other than Glass), Reinforced Plastics Building Materials, and Industrial Design.

Session I—Strength-Time Behavior of Reinforced Plastics (Test Methods and Fibers other than Glass)

Presiding: James W. Case, U. S. Department of the Navy, Bureau of Ordnance, Washington, D. C. Vice Chairman: B. D. Raffel, Goodyear Aircraft Corp.

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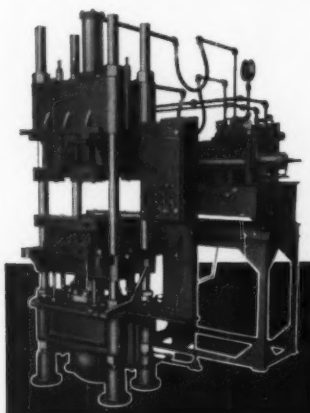

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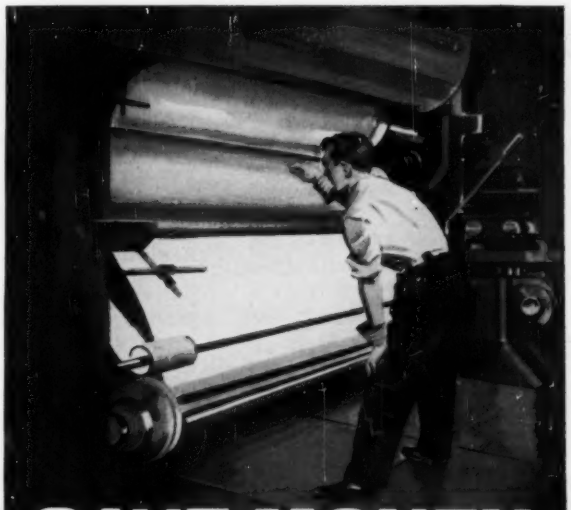

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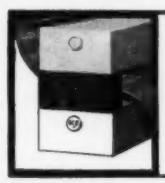

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"Unidirectional Glass Reinforced Plastic Ring Structures," N. Chessin, General Electric Company.

"Creep of Laminated Epoxies," John Delmonte, Furane Plastics, Inc.

"Laminates Reinforced With Asbestos," Norman E. Wahl and Harold M. Preston, Cornell Aeronautical Laboratory, Inc., Cornell University.

Authors' Panel Discussion

Session II—Reinforced Plastics Building Materials

Presiding: Prof. Frederick J. McGarry, Massachusetts Institute of Technology. Vice Chairman: George R. Huisman, Filon Plastics Corp.

"Structural Sandwich Panels in Building Applications," Arthur N. Williams, Haskelite Manufacturing Corp.

"Some Factors Influencing Durability of Glass Reinforced Laminates," Arthur L. Smith and John R. Lowry, Rohm & Haas Co.

"The Monsanto Inorganic Research Laboratory Building," M. F. Gigliotti, Monsanto Chemical Co.

"Building Codes As Applied to Reinforced Plastics Building Materials," Frank X. Ambrose, Alsynite Co. of America.

"The Brussels Exhibition—The World's Largest Plastic Structure," Prof. Albert G. H. Dietz, Massachusetts Institute of Technology.

Authors' Panel Discussion

Session III—Industrial Design

Presiding: J. McLeod Little, ASID, J. M. Little Associates. Vice Chairman: Hiram McCann, Editor, MODERN PLASTICS Magazine.

"Seats, Sides, and Suitcases," John W. Hauser and D. W. Hawley, John W. Hauser, Inc., Industrial Design.

"The Application of Reinforced Plastics to Transportation Uses," Alan Cripe, I.D.I., Chief Designer, The Chesapeake & Ohio Ry.

8:30 to 10:30 P.M. Three concurrent sessions on the subjects of Strength-Time Behavior of Reinforced Plastics (Speed-Temperature-Radiation), Premix Molding and Compounding, and Preforming.

Session I—Strength-Time Behavior (Speed, Temperature, Radiation)

Presiding: L. S. Lazar, General Electric Co. Vice Chairman: Bruce Godard, Bakelite Co., a Division of Union Carbide Corporation.

"Effects of High Intensity Thermal Radiation on Plastic Laminates," H. S. Schwartz and B. J. Lisle, Wright Air Development Center, Wright-Patterson Air Force Base, Ohio.

"Effects of Elevated Temperature and Erosion on Reinforced Plastic Laminates," Norman B. Miller and Eric L. Strauss, The Martin Co.

"Radome Materials for Operating Temperatures Above 500° F." Roland A. Tripp and Francis Bozzacco, Goodyear Aircraft Corp.

"Behavior of Reinforced Plastics at Very High Temperatures," L. H. Shenker and I. J. Gruntfest, General Electric Co.

Authors' Panel Discussion

By title only:

"Subsonic and Supersonic Rain Erosion," J. P. Peterson, Wright Air Development Center, Wright-Patterson Air Force Base.

Session II—Premix Molding and Compounding

Presiding: James L. Harvey, Consultant. Vice Chairman: Lawrence Wittman, Lawrence Wittman & Co.

"A Comparison of Phenolic and Polyester Premix Materials," J. J. Colao and M. M. Gurvitch, Barrett Div., Allied Chemical & Dye Corp.

"Report of the Premix Standards Committee," Lawrence Wittman, Lawrence Wittman & Co.

"Physical Properties of Transfer and Compression Molded Premix Materials," R. H. Calderwood and H. R. Sheppard, Westinghouse Electric Corp.

Authors' Panel Discussion

By title only: *"Applications and Suggested Uses of Polyester Premixes,"* C. W. Proudfit, Celanese Corp. of America. *"A New High Strength Molding Material,"* S. G. Salzinger and Henry M. Toellner, Coast Manufacturing & Supply Co.

Session III—Preforming

Presiding: Arthur J. Wiltshire, Apex Reinforced Plastics Div., White Sewing Machine Corp. Vice Chairman: G. W. Burton, Westinghouse Electric Corp., Micarta Div.

"Automatic Preforming Equipment," Charles D. Jones, Structurlite Plastics Corp.

"A Product History of Preforming Without Discoloration," Robert E. Mollman, Plastic Products Corp.

"Mold Design to Compensate for Warpage in Reinforced Plastics Parts," Thomas Harris, Structural Fibers, Inc.

"Technical Features of the Rotary Roving Cutter Using Carbide Blades," L. E. Swanson, Turner Machine Co., Inc.

Authors' Panel Discussion

By title only: *"The Pressurform Process of Preforming,"* S. H. A. Young, Pressurform Container Corp.

Wednesday, Feb. 5

9:00 A.M. to 12:00 noon. Three concurrent sessions on the subjects of Research, Processing, and Plastics Tooling.

Session I—Research Symposium

Presiding: W. Burdette Wilkins, Consulting Engineer. Vice Chairman: George A. Stein, A. O. Smith Corp.

"Fundamental Studies of Adhesion," J. J. Bikerman, Adhesives Research Laboratory, Massachusetts Institute of Technology.

"Resin-Glass Bond Characteristics," Prof. F. J. McGarry, Dept. of Civil and Sanitary Engineering, Massachusetts Institute of Technology.

"Behavior of Fibrous Glass Laminates from Interior Strain Measurements," Richard E. Chambers, Plastics Research Laboratory, Massachusetts Institute of Technology.

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and Process Variables on Laminate Properties," Dr. William G. Carson and Arthur L. Smith, Rohm & Haas Co.

"Design and Operation of a Rosette Extensometer," Professors A. G. H. Dietz and F. J. McGarry, Massachusetts Institute of Technology.

Authors' Panel Discussion

Session II—Processing

Presiding: P. Robert Young, Wallace & Tiernan, Inc. Vice Chairman: George Lubin, Lawrence Wittman & Co.

"Vacuum Pressure Injection Molding of a Helicopter Reinforced Plastic Contravane," Kurt A. Schneider, Sikorsky Aircraft, Div. United Aircraft Corp.

"Simultaneous Deposition of Resin and Reinforcement," David F. Anderson, Fibercut Appliances, Ltd., Montreal, P.Q.

"Development of a Reinforced Plastic Jato Motor," John J. Scavuzzo, Samuel Feltman Ammunition Laboratories, Picatinny Arsenal.

"Reinforced Plastic Bathtub Fabrication Methods," C. H. Van Hartesveldt, Sterling Precision Corp., Fiber Glass Plastics Div.

"Asbestos Reinforced Plastics Motor for Vanguard Rocket Components," Edward G. Dingman, The Martin Co.

Authors' Panel Discussion

By title only: *"Contour Weaving of Reinforcement,"* A. R. Campman and Edward Koppelman, Raymond De Icer & Engineering Co.

Session III—Plastics Tooling

Presiding: Fred Lyijynen, Chrysler Corp., Stamping Div. Vice Chairman: Edward A. Jonasch, Jonasch Plastics Co.

"Cure Shrinkage of Epoxy Resin Systems," H. L. Parry and H. A. MacKay, Shell Chemical Corp.

"Mold Making by Electroforming," S. Fialkoff, Camin Laboratories, Inc.

"A Study of Laminated Tooling Reinforcements," Norbert E. Talbert, Republic Aviation Corp., Non-Metallics Section.

"New Fiber Reinforced Epoxy Compositions," A. P. Mazzuc-

chelli, Bakelite Co., Div. Union Carbide Corp.

Authors' Panel Discussion

12:00 to 1:00 P.M.—Informal Luncheon—no speakers.

1:00 to 5:15 P.M.—Personal Contact Periods.

6:00 P.M. — Reception — Sponsored by materials companies.

7:00 P.M.—Annual banquet. Toastmaster: Clare E. Bacon, Owens-Corning Fiberglas Corp. and General Chairman of S.P.I. Reinforced Plastics Div. Executive Committee Awards.

Thursday, Feb. 6

9:00 A.M. to 12:00 noon. Three concurrent sessions on Management, Filament Winding, and Boat Construction.

Session I—Management

Presiding: A. W. Levenhagen, Molded Fiber Glass Tray Co. Vice Chairman: Harriet Raymond, Celanese Corp. of America.

"Accounting—History or Working Tool?" W. H. Nussbaum, C. P. A., Consultant in Accounting.

"Advertising and Public Relations," Charles H. Sapper, Lando Advertising Agency.

"Getting Team Unity in the Growing Corporation—A Case Study," Roger B. White, The Glastic Corp.

"Market Research for Reinforced Plastics," Joseph B. Durra, J. B. Durra & Co.

Authors' Panel Discussion

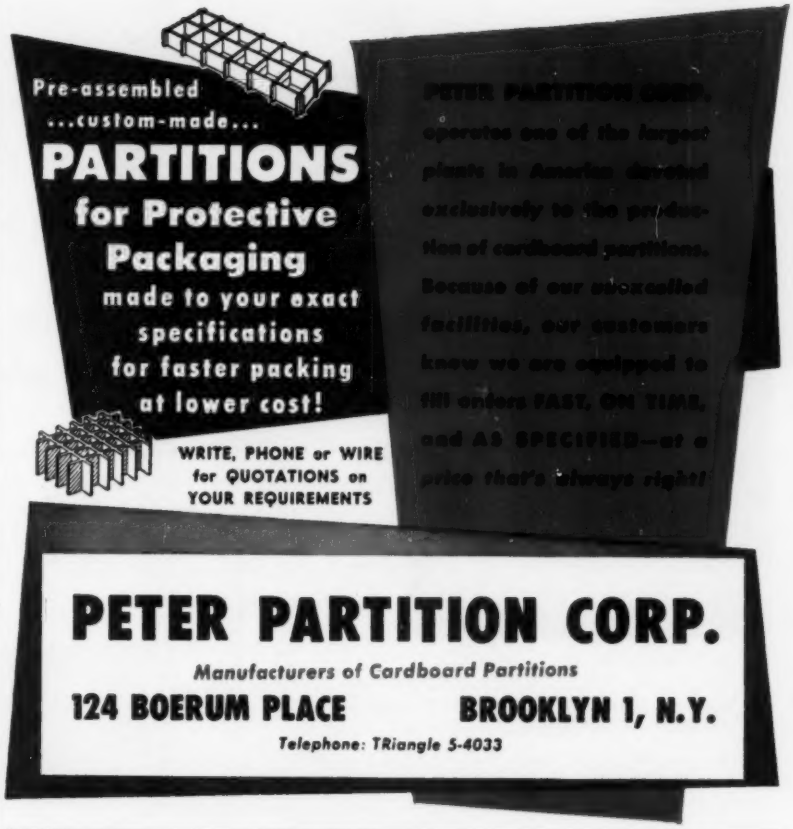
By title only: *"Reinforced Plastic Transportation Equipment: A Bright Future,"* Kenneth C. Sanders, The Heil Co.

Session II—Filament Winding

Presiding: Samuel S. Oleesky, Zenith Plastics Co. Vice Chairman: Donald G. Estey, American Cyanamid Co.

"Filament Wound Structures," Robert L. Noland, Reinhold Engineering & Plastics Co.

"Development of Improved Filament-Wound Pressure Vessels," George Epstein, Harry A. King, and Robert H. Bendarzewski, Aerojet-General Corp., Subsidiary of The General Tire & Rubber Co.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"The History and Potential of Filament-Winding," Richard E. Young, Young Development Laboratories, Inc.

"Filament-Winding Developments for Rocket Applications," Richard Gorcey, Rocketdyne, Division of North American Aviation, Inc.

Authors' Panel Discussion

Session III—Boat Construction

Presiding: Harry L. Darby, Winner Manufacturing Co., Inc. Vice Chairman: Ralph Della Rocca, Gibbs & Cox, Inc.

"Developing a Boat," E. F. Culwick, Winner Manufacturing Co., Inc. and D. Savitsky, Stevens Institute of Technology.

"Boat Styling—A Reflection of the Times," John David Beinert, Member, American Society of Industrial Designers.

"Plastic Boats in the United States Navy," Cmdr. C. L. Fears and Henry Shek, Dept. of the Navy, Bureau of Ships.

"Reinforced Plastics as Protective Coatings for Wood," Richard Mark, Balsa Ecuador Lumber Corp., and Bert M. Zuckerman, Wood Products Pathologist and Consultant.

"Evaluation of Laminate Construction for Boats," L. Dow Moore and Peter Lahde, Ferro Corp., Fiber Glass Div.

Authors' Panel Discussion

12:30 to 2:00 P.M.—Luncheon. Toastmaster: Hiram McCann, Editor, MODERN PLASTICS Magazine. Principal Speaker: Henry Dreyfuss, Industrial Designer.

A showing of two new motion pictures sponsored by the U. S. Department of the Navy, Bureau of Ships: Number MN-8597A (black and white) "Reinforced Plastics—Introduction." Number MN-8597B (color) "Reinforced Plastics—Inspection and Quality Control."

2:00 to 5:00 p.m.—Open Forum. Presiding: Robert J. Brinkema, Firmaline Products, Inc. Vice Chairman: Samuel S. Oleesky, Zenith Plastics Co. During this session, questions from the floor are to be posed to authors of papers delivered at the three-day Conference.

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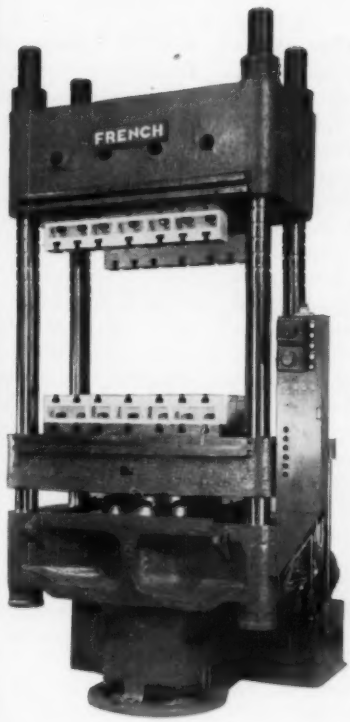

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Plastics Digest*

Abstracts from the world's literature of interest to those who make or use plastics or plastics products. For complete articles, send requests direct to publishers. List of addresses is at the end of Plastics Digest.

General

Where are synthetic-fiber papers headed? J. R. Emery and P. L. Lantos. Paper Trade J. *141,* 39-40 (Mar. 25, 1957). Non-woven fabrics of synthetic fibers are already replacing woven fabrics in certain applications. Paper from synthetic fibers and from synthetic fiber-wood pulp fiber blends should have a broad versatility in both the paper and fabric fields. Paper from synthetic fibers has a tear strength about 10 times that of a good kraft paper, has excellent wet strength, resistance to heat, chemicals and weathering, as well as good dimensional stability. By picking the right binder the paper can be made transparent, resistant to crazing and cracking, and provide excellent electrical properties and fold endurance. Current major emphasis is on finding binders which will allow more advantage to be taken of the strength of nylon, Dacron polyester, and Orlon acrylic fibers. Development of new fibers specifically for paper making is another goal. Market research is being emphasized. About 25 end uses are under investigation, with many more to come.

Materials

Budding competition of PVP's markets? Chem. Week *81,* 57-58 (Aug. 17, 1957). Uses for copolymers and homopolymers of N-2-vinylpyrrolidone are discussed.

How much do you know about wet strength papers? K. W. Britt. Paper Trade J. *141,* 36-40 (July 1, 1957). A review of wet-strength paper—what it is, its uses, the different methods of making it—is presented. The two most common means of preparing it are by incorporation of urea-formaldehyde or melamine-formaldehyde resin, each of which has its advantages. The processes are described in detail. Other wet-strength processes are evaluated.

Stretching of cellulose derivative film. T. Suda. J. Fac. Textile Sericult. Shinshu Univ. Ser. C, *3,* 1-32 (1956). (In English) The effect of stretching was determined on various properties of cellulose acetate, ethyl cellulose, cellulose nitrate, carboxymethyl cellulose, saponified cellulose acetate, and other cellulose derivative films. Tensile strength and Young's modulus generally increased with degree of stretching and also with degree of polymerization up to 300. Elongation increased to a maximum and then decreased except for carboxymethyl cellulose and cellulose xanthate. Stretching had no effect on heat softening. Double refraction increased with an increase in molecular weight and with an increase in stretching.

Molding and fabricating

Continuous control of viscosity. R. A. Menard. Automation *4,* 61-3 (Sept. 1957). An instrument used for continuous indication, recording, and control of viscosity under processing conditions is described.

Tooling for manufacture of plastic insulated commutators. A. Arnott. Machine & Tool Blue Book *52,* 149-50, 52, 54, 56 (Sept. 1957). The use of plastics in building commutators for electric motors is important for insulating the copper segments from each other and for molding the segments into a circle after the commutator is assembled. Diagrams are presented and details are given for using a machine which will accomplish this satisfactorily.

Cutting plastics with portable electric tools. J. L. Bennett. Plastics Tech. *3,* 557-58 (July 1957). Cutting plastics with power saws and drills is discussed briefly.

Production and application of hard nickel electroformed molds and dies. P. Spiro. Chem. Ind. Internationale No. 2, 59 (June 1957). The advantages, method of producing, fields of application, and special uses of hard nickel electroformed molds and dies for molding plastics articles are discussed.

Sticky problem—applying adhesives. R. M. Shores, Jr. Instrumentation *10,* 21-23 (July/Aug. 1957). The use of process control instruments in a plant producing pressure-sensitive adhesive paper tapes is described.

A new weld for vinyls. Canadian Plastics *1957,* 63, 67 (Aug.). Special electronic controls and magnetic force welding result in a new type projection weld, accomplished in one millisecond, which permits welding of steel clad with chloride plastic to other metals.

Applications

Plastic solder for automobile sheet metal repairs. Automotive Ind. *117,* 118, 122 (Aug. 1, 1957). The advantages of using an epoxy resin solder for automobile repairs are pointed out and a brief description of the method of application is given.

Synthetic fibers—the future. F. J. Soday. Chem. Eng. Prog. *53,* 307-10 (June 1957). The future potential for synthetic fibers is discussed, with the requirements for the major end uses kept in mind. In the apparel field, aesthetic qualities and styling are generally more important than utility. Fibers for industrial applications are chosen mainly from the standpoint of physical properties and price. Pilling, fibrillation, and dyeing problems associated with synthetic fibers can now be controlled; this has led to

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a rapid upsurge of interest in such fibers on the part of the textile industry. Other new developments of importance in widening the field of utilization of synthetic fibers are the processes for production of isotactic polymers with greatly improved crystallinity, the synthesis of block and graft copolymers with radically different properties from the usual copolymers, radiation polymerization to give fibers with improved thermal resistance and strength, and the development of new yarn and spinning techniques. It is predicted that the use of synthetic fibers for all purposes will increase to about 1.1 billion lb. by 1965 and that it will reach 4 billion lb. by 1975.

Containers and packaging industry report. Business and Defense Services Administration Report *10*, 36 pp. (Summer 1957). Production statistics on containers and materials used in making containers and in packaging are presented. Available from U. S. Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Building codes stymie more plastics use. Chem. Week *81*, 95-6, 98, 100 (Aug. 17, 1957). The increase in the use of plastics in building, the problems concerned with building codes, and the types of building items that are available in plastics are discussed.

Properties

Relation of intrinsic viscosity to cellulose chain length. Degree of polymerization range below 400. W. J. Alexander, O. Goldschmid, and R. L. Mitchell. Ind. Eng. Chem. *49*, 1303-06 (Aug. 1957). The difference between actual or contour length of a cellulose chain and its effective behavior length depends on the type of solution and length of chain itself. Intrinsic viscosities determined for cellulose nitrates in ethyl acetate compared directly with those obtained for the corresponding primary celluloses in cupriethylenediamine. Similar viscosity comparisons were made for cellulose acetates in acetone and cupriethylenediamine, which saponifies the acetate without degradation. Cellulose nitrate in ethyl acetate has the highest intrinsic viscosity and the ratio of effective to actual chain length changed the least with degree of polymerization. Above DP 400, estimated factors for converting the measured intrinsic viscosity to degree of polymerization are 175 for cellulose in cupriethylenediamine, 135 for cellulose diacetate in acetone, and 75 for cellulose trinitrate in ethyl acetate; at DP 10, conversion constant for all three systems is about 75.

Testing

A method for measuring solvent resistance of crystal-to-crystal adhesive bonds. B. J. Faraday and D. J. G. Gregan. ASTM Bulletin No. *222*, 42-45 (May 1957). A method for determining the solvent resistance of adhesive bonds is described. In this method the bonded adherends are used to close a Microswitch in such a manner that when the bond separates as a result of being immersed in solvent or chemical, the switch opens.

Testing of foil-clad laminates for printed circuitry. T. D. Schlabach, E. E. Wright, A. P. Broyer, and D. K. Rider. ASTM Bulletin No. 222, 25-30 (May 1957). The testing of foil-clad plastics laminates is described. Departure from the more conventional test methods are dictated by both the material under consideration and its principal end use in printed circuitry. The intent in every case, however, is to make the test methods and accompanying test specimens as widely applicable as possible, and also to utilize existing test methods wherever practicable. The testing procedures outlined have been employed by diverse groups for over a period of 1½ yr., and the principal shortcoming and advantages of each are pointed out. The numbers of individual test specimens upon which these generalizations are based, for the various methods described, range from the hundreds into the thousands. It is apparent that only a few of the basic parameters of interest to both the materials and design engineer have been covered so that one may expect not

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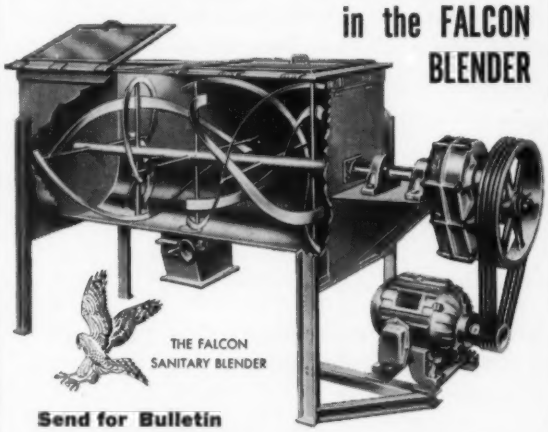

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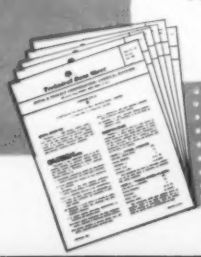

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only improvements in the methods described but also the inclusion of new test methods in the future.

Calculation of composition of epoxy resin esters. K. A. Earhart and L. G. Montague. Ind. Eng. Chem. *49*, 1095-98 (July 1957). In calculating epoxy resin esters three reactions should be taken into consideration: reaction of acid groups with epoxy groups with no liberation of water (this reaction is preferential); reaction of acid groups with hydroxy groups with liberation of water; and reaction of epoxy groups with hydroxyl groups with no liberation of water. Ignoring the third, an equation for calculating the water that should theoretically be produced in preparing esters is derived. The recommended method presents calculations in terms of parts of starting ingredients, percentages of starting ingredients, equivalent weights, parts of equivalents used, and percentages of ingredients in 100 parts of ester. Five composition categories for discussing epoxy resin esters are suggested. Comparison with actual water data that were obtained from laboratory experiments indicates that the suggested method of calculation, which ignores the epoxy-hydroxy side reaction, is sufficiently accurate over practical ester composition ranges.

Publishers' addresses

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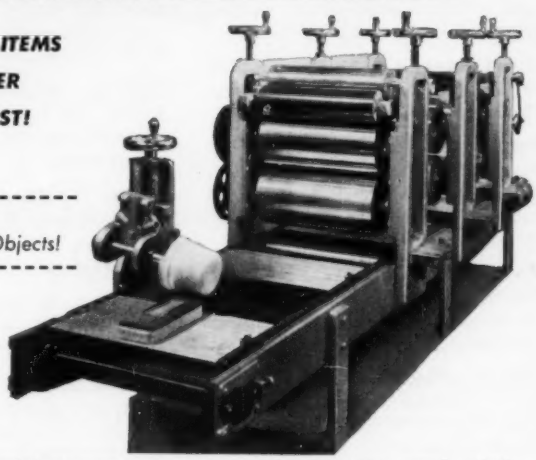

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Molding. W. J. Davis (to Polymer). U. S. 2,802,237, Aug. 13. Molding polyamides.

Press. R. Colombo (to S. A. S. Lavorazione Materie Plastiche). U. S. 2,802,238, Aug. 13. Screw press for working plastics.

Cellular articles. F. W. Thomas (to Lockheed). U. S. 2,802,240, Aug. 13. Molding cellular plastics.

Containers. L. Rado. U. S. 2,802,-324, Aug. 13. Liquid-filled sealed plastic containers.

Printing. E. Lecluyse and A. Quinche (to Unitubo). U. S. 2,802,-412, Aug. 13. Apparatus for printing on plastic surfaces.

Expanded plastic. I. J. Filler. U. S. 2,802,430, Aug. 13. Apparatus for expanding plastic products.

Foam resin. E. Simon and F. W. Thomas (to Lockheed). U. S. 2,802,-795, Aug. 13. Cellular reaction products of toluenediisocyanate and an alkyd resin.

Vinyl ester. H. A. Toulmin, Jr. and W. R. Stauffer. U. S. 2,802,796, Aug. 13. Porous vinyl ester.

Resin. F. J. Sprules and H. C. Marks (to Wallace and Tiernan). U. S. 2,802,800, Aug. 13. Polyvinyl ester resin plasticized with an epoxy stearic acid ester.

Polyvinyl resins. R. J. Reid, W. M. Smith, Jr., and B. H. Werner (to Firestone). U. S. 2,802,802-3-4, Aug. 13. Plasticized polyvinyl resins.

Construction members. K. Dietz (to Farbwerke Meister Lucius and Bruning). U. S. 2,802,805, Aug. 13. Shaped construction members.

Polymers. J. G. N. Drewitt (to British Celanese). U. S. 2,802,807, Aug. 13. Carbonate polymers.

Resin. R. A. Hayes (to Firestone). U. S. 2,802,808-9, Aug. 13. Styrene-acrylonitrile polymers.

Resins. C. G. Overberger (to L. A. Dreyfus). U. S. 2,802,812, Aug. 13. p-Alkyl styrene polymers.

Resins. J. B. Maguire and G. M. Fohlen (to Allied Chemical). U. S. 2,802,813, Aug. 13. Terpene resins.

Polymerization. M. Feller and E. Field (to Standard Oil). U. S. 2,802,-814, Aug. 13. Ethylene polymerization.

Milling. W. R. Marshall (to Carbide and Carbon). U. S. 2,803,039, Aug. 20. Continuous plastic milling.

Extrusion. J. Hill and A. P. Berger (to Celanese). U. S. 2,803,041, Aug. 20. Extrusion of plastics.

Extrusion. K. Lundh (to Anstalt Unda). U. S. 2,803,042, Aug. 20. Extrusion of tubes.

Sheet. H. H. Holly (to Hollymatic). U. S. 2,803,438, Aug. 20. Sheet feeding means for plastic molding.

Polymerization. J. F. Black and W. C. Hollyday, Jr. (to Esso). U. S. 2,803,598-9, Aug. 20. Gamma-ray activated polymerization.

Cellular resins. D. E. Weyer (to Dow Corning). U. S. 2,803,606, Aug. 20. Cellular siloxane resins.

Molding composition. C. A. Richie (to Owens-Illinois). U. S. 2,803,608, Aug. 20. Phenolic molding compositions.

Resin. F. Schlenker (to Chemische Werke Albert). U. S. 2,803,609, Aug. 20. Epoxy resin and method for hardening.

Resin. H. C. Moyer (to Sinclair). U. S. 2,803,612, Aug. 20. 9-Octadecenamide-polyethylene compositions.

Textile treatment. W. S. Kather, A. A. Litster, and E. D. Brown, Jr. (to General Electric). U. S. 2,803,613, Aug. 20. Organopolysiloxane composition.

Polymers. A. H. Ahlbrecht, H. A. Brown, and S. Smith (to Minnesota Mining). U. S. 2,803,615, Aug. 20. Polymers of fluorocarbon acrylates.

Polysiloxanes. H. A. Clark (to Dow Corning). U. S. 2,803,616, Aug. 20. Preparing organopolysiloxanes.

Polysiloxanes. M. L. Corrin (to General Electric). U. S. 2,803,617, Aug. 20. Preparing organopolysiloxanes.

Resins. M. T. Harvey (to Harvel). U. S. 2,803,618, Aug. 20. Ketone-furfural resins.

Copolymerizing. E. C. Chapin (to Monsanto). U. S. 2,803,622, Aug. 20. Copolymerizing acenaphthene with styrene.

Resin. R. Lotz (to Glanzstoff-Fabriken). U. S. 2,804,434, Aug. 27. Polycondensate of methylene-bis-chloropropionic acid amide.

Foam plastic. R. A. Reed (to Whiffen and Sons). U. S. 2,804,435, Aug. 27. Foamed vinyl resin.

Coating. D. D. Ritson (to American Cyanamid). U. S. 2,804,436, Aug. 27. Starch-clay-polyacrylamide coating.

Molding compound. L. P. Biefeld and R. F. Shannon (to Owens-Corning). U. S. 2,804,438, Aug. 27. Fibrous glass reinforced resinous molding compound.

Resin. E. K. Drechsel (to American Cyanamid). U. S. 2,804,439, Aug. 27. Rosin-vinylsilane adducts and polymers thereof.

Resin. R. F. Nickerson (to Monsanto). U. S. 2,804,441, Aug. 27. Compositions of methyl ethers of polymethylol melamine.

Aminoplasts. W. A. Laurie (to Monsanto). U. S. 2,804,442, Aug. 27. Thermosetting aminoplasts.

Polystyrene. J. W. L. Fordham (to Monsanto). U. S. 2,804,443, Aug. 27. Polystyrene toughened with oxidized polyisobutylene.

Resins. F. H. Snyder (to Dendrol). U. S. 2,804,445, Aug. 27. Resins from hydroxymethyl furfural and para-toluenesulfonamide.

Resins. H. H. Roth (to Dow). U. S. 2,804,446, Aug. 27. Water-soluble vinyltoluene acrylic ester copolymer sulfonates.

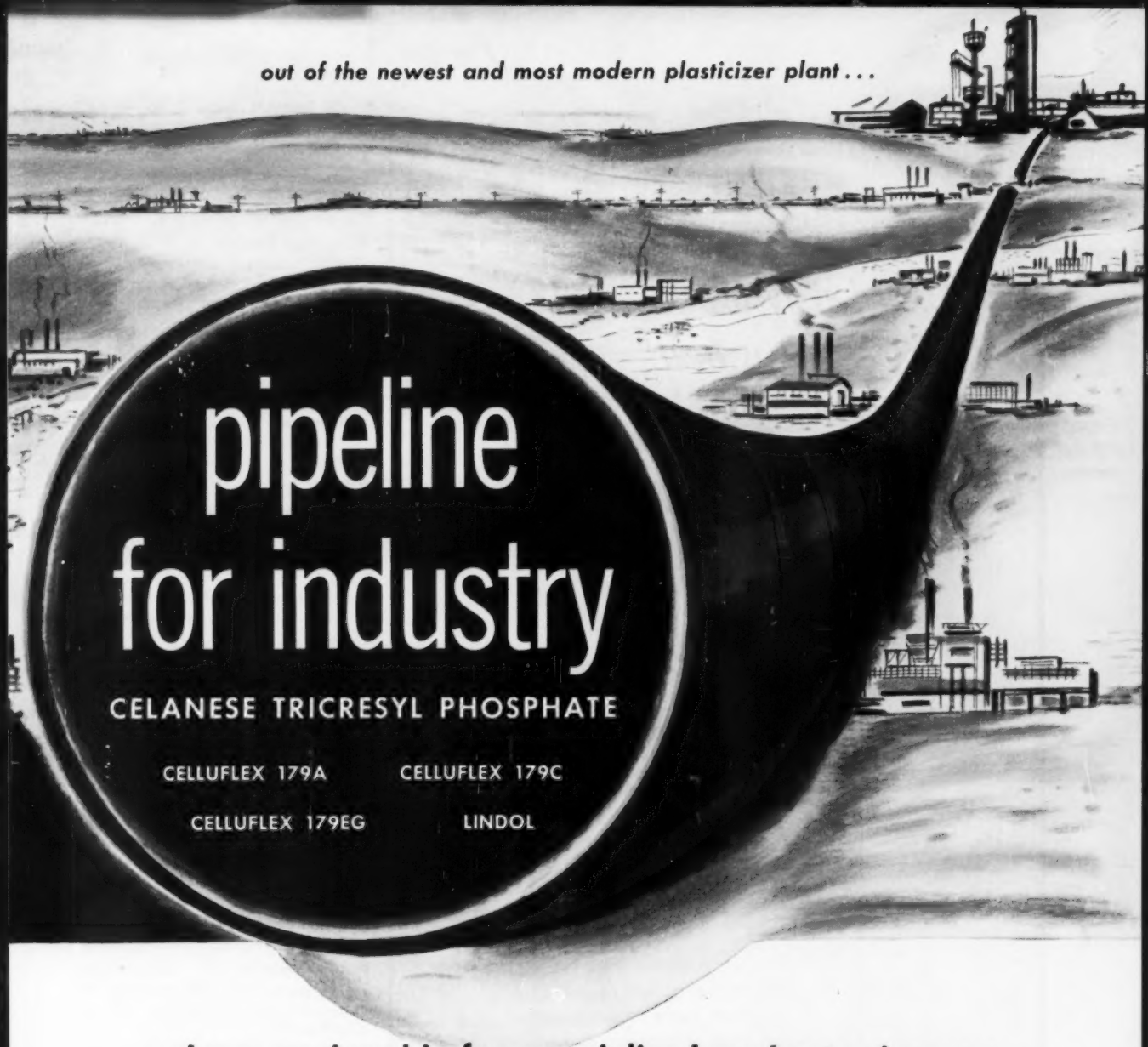
Elastomers. V. L. Hallenbeck (to B. F. Goodrich). U. S. 2,804,448, Aug. 27. Chlorinated isoolefin polyolefin interpolymers.

Tubing. D. T. Milne (to American Viscose). U. S. 2,804,642, Sept. 3. Apparatus for continuous expansion of plastic tubing.

Molding. R. G. Strauss (to Plax). U. S. 2,804,648, Sept. 3. Plastic blow molding.

Molding. B. J. D. Hupfield. U. S. 2,804,649, Sept. 3. Plastic molding machines.

Sheet. S. A. Balkan (to Polaroid);



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U. S. 2,804,652, Sept. 3. Stretching plastic sheet.

Devolatilizer. C. C. Perkins, C. Jones, and A. F. Roche (to Dow). U. S. 2,804,920, Sept. 3. Devolatilizer for viscous fluid polymers.

Cellulose acetate. R. F. Williams, Jr. (to Eastman Kodak). U. S. 2,805,171, Sept. 3. High acetyl cellulose acetate molding composition.

Film. A. E. Ambler (to Imperial Chemical). U. S. 2,805,173, Sept. 3. Polyethylene terephthalate photographic film base.

Laminate. F. Groff and C. F. Martino (to Carbide and Carbon). U. S. 2,805,181, Sept. 3. Thermoplastic glass fiber laminate.

Elastomeric structure. V. L. Hallenbeck (to B. F. Goodrich). U. S. 2,805,182, Sept. 3. Elastic polyurethane elastomer composites.

Foamed solid. I. D. Roche (to Du Pont). U. S. 2,805,208, Sept. 3. Foamed resin.

Resin. A. H. Bowen and J. R. Ash (to Monsanto). U. S. 2,805,209, Sept. 3. Resin product of phenol, formaldehyde, and cellulose.

Polymer. S. J. Hetzel (to Sun Oil). U. S. 2,805,211, Sept. 3. Polymer of vinyl aromatic compound with a petroleum hydrocarbon.

Interpolymers. J. R. Caldwell and J. W. Wellman (to Eastman Kodak). U. S. 2,805,213, Sept. 3. Interpolymers of mixtures of p,p'-sulfonyl dibenzoic acid and cyclic aliphatic dicarboxylic acids.

Polymerization. J. Zimmerman (to Du Pont). U. S. 2,805,214, Sept. 3. Polymerization of a lactam with a mixed catalyst.

Copolymers. J. R. Caldwell and E. H. Hill (to Eastman Kodak). U. S. 2,805,215, Sept. 3. Addition copolymers of allyloxamic acid hydrazides.

Polyethylene. L. E. Wolinski (to Du Pont). U. S. 2,805,960, Sept. 10. Gaseous treatment of polyethylene.

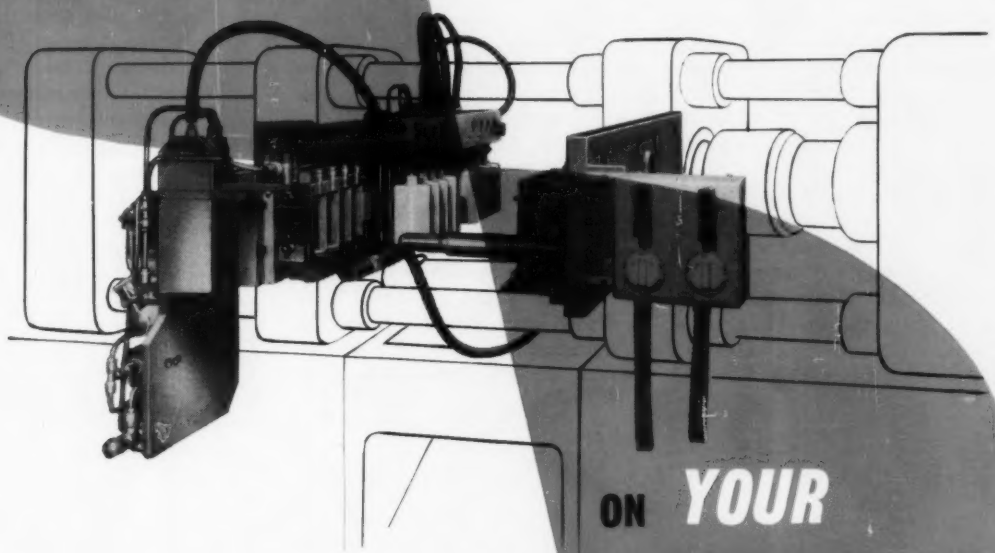
Plastic treatment. W. M. Lee and L. P. Muller (to Pennsalt). U. S. 2,805,964, Sept. 10. Antistatic treatment of plastic.

Resin. K. L. Proctor and H. L. Katz. U. S. 2,806,006, Sept. 10. Phenolic resin.

Resin. C. B. Linn (to Universal Oil Products). U. S. 2,806,007, Sept. 10. Resins from phenol, alginic acid, and formaldehyde.

Polymers. J. Dazzi (to Monsanto). U. S. 2,806,011, Sept. 10. Plasticized polyvinyl chloride.

AUTOMATIC BLOW MOULDING



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New Machinery and Equipment*

Injection machines

The Automolder line of 2-oz. machines consists of three machines having clamping capacities of 25, 50, and 75 tons, with corresponding dry-cycle times of 3, 1.8, and 1.8 seconds. All are rated for 30 to 40 p.p.h. plasticating capacity and maximum mold size of 9 by 10 inches. The 25- and 75-ton machines will accept molds up to 6 in. thick and have top strokes of 6.8 in., while the 50-tonner takes molds up to 9 in. thick, has strokes up to 9 in., and has maximum daylight opening of 18 in.; the other two are limited to 12.8 inches. All are powered by 2000-p.s.i., 13.4-gal./min., Vickers pumps driven by 15-hp. motors, and are equipped with 10 gal. accumulators. Up to three machines can be serviced by one hydraulic drive unit. *Standard Tool Co., 221 Hamilton St., Leominster, Mass.*

Sprue recovery system

The Liberty system of sprue recovery (see diagram below) consists of a unified apparatus that collects sprues as they drop out of the molding machine, regrinds them, blends regrind with correct weight of make-up virgin feed, transports mixture to feed hopper of machine, and maintains machine hopper level. All these functions have recently been integrated into a single frame, mounted on casters for convenience. A slow conveyor that lifts sprues and runners to granulator gives them time to cool to a good grinding temperature. Mixing of reground and virgin is done by a centrifugal cyclone aided by the pneumatic transport system. Color changes, of course, require thorough cleaning, and, where feasible, it is recommended that the portable units be moved from machine to machine, following the colors, to minimize the number of changes. Floor space required is 2 by 7.5 ft., height is 8.5 feet. *Liberty Engineering and Mfg., Co., 1450 S. 15th St., Louisville, Ky.*

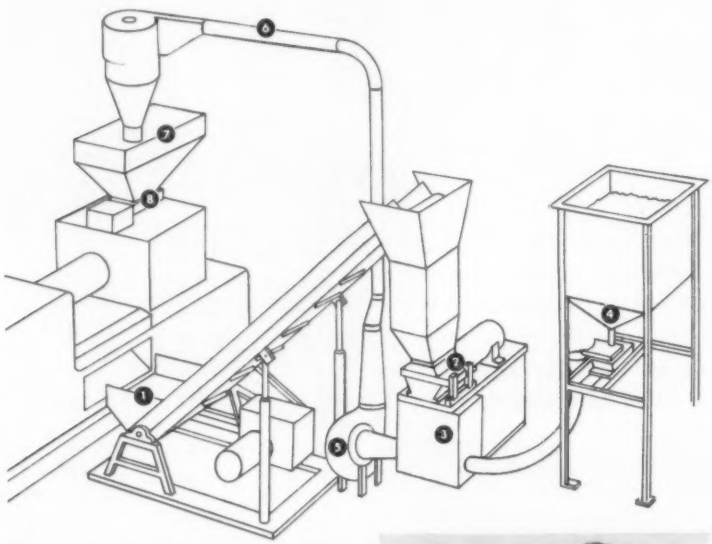

Diagram of Liberty Engineering sprue-recovery set-up: 1—Automatic conveyor collects sprue, elevates it for grinding; 2—sprue granulators; 3—mixing hopper, with air inlets for ground sprue and virgin plastic; 4—virgin plastic feed; 5—fan blender combines ground sprues and virgin material; 6—air transporting system for conveying mixture; 7—level control; 8—machine hopper. Over-all view of machine is at right

Vacuum coater

The LC1-30 metallizer, designed for the small- or medium-volume finisher, can cycle five to seven times per hour. On a typical job, 400 to 600 pieces 1.5 in. in diameter can be metallized in an hour. The work chamber is a 30- by 45-in. steel tank with a hinged door at one end. Pumping system consists of a 14-in. oil-diffusion pump, a 110-cu. ft./min. roughing pump, and a 3.5-cu. ft./min. holding pump, all interlocked to prevent burning of the diffusion-pump oil. With a clean, dry system, pump-down time to 0.5 micron Hg is 5 min.; lowest pressure is 0.03 micron. Instrumented and equipped with roughing, backing, and air-inlet valves, and a water-cooled high-vacuum valve, the unit requires a space (height, width, depth) of 9 by 6 by 13 feet. *Consolidated Electrodynamics Corp., 1775 Mt. Read Blvd., Rochester 3, N.Y.*

Mattress maker

A large machine combining electronic heat-sealing equipment with an 80- by 30-in. air-operated press, makes possible the fabrication of a complete chaise longue mattress in 15 seconds. Mattresses 78 by 26 by 4 in. are made by

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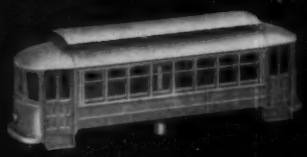
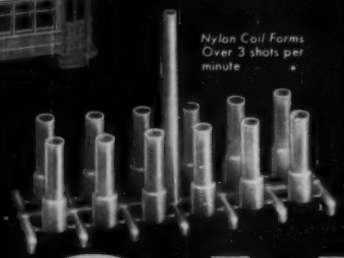
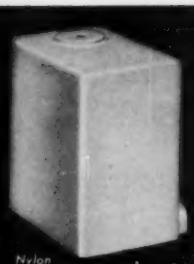
Nylon Gears
3 shots per minute



Nylon Scale Model Car
3 shots per minute



Nylon Coil Forms
Over 3 shots per minute



Nylon
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VAN DORN Presses mold it better

Van Dorn Scrap Granulator. Grinds your nylon sprues and runners for immediate reuse

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1. Faster purging insures less waste of valuable nylon than with larger machines.

2. Closer tolerances are maintained due to fewer cavities in molds.

3. Inexpensive molds, lower price of press, and fast cycling keep costs to a minimum.

4. Shorter sprues and runners reduce scrap.

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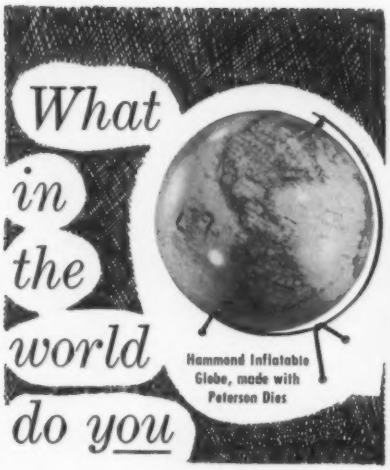

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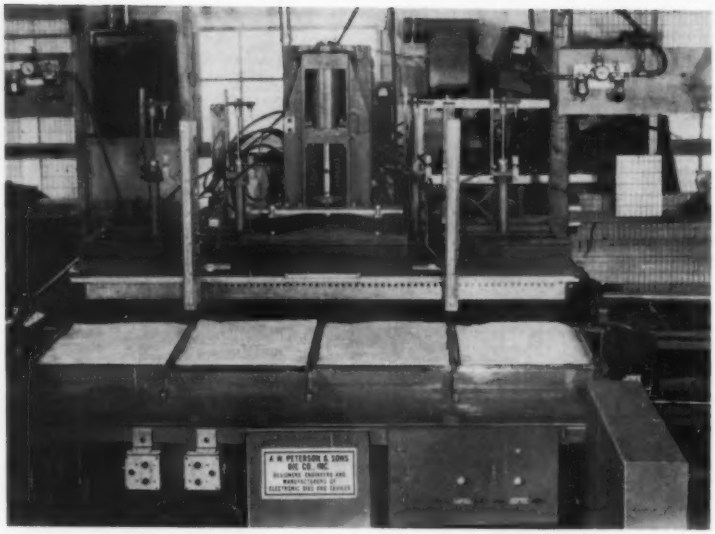


A. W. Peterson & Sons mattress-making machine. Fibrous glass pads are in loading trays, ready to move into position between vinyl sheets on press bed

sealing four pads of fibrous glass within two layers of vinyl sheeting, with a seal between each pair of pads. The sealing die, powered by a standard Radio Receptor 25-kw. generator, simultaneously seals and trims the outer area. Pads are preloaded into loading trays; vinyl sheeting is roll-fed; finished mattress ejects to conveyor. *A. W. Peterson & Sons Die Co., Inc., 131 Prince St., New York 12, N.Y.*

Multi-color hot stamping press

The Model 2AH press has been modified to include automatic control of dwell period, pressure, and pre-heat contact. A new arrangement on the press head makes possible the stamping of two or three colors at one time. Operating speed is 130 two-color pieces per min. at 100% loading. A wide variety of regular and irregular shapes can be handled. *The Acromark Co., 5-15 Morrell St., Elizabeth 4, N.J.*

Pre-expander facilitates molding of polystyrene foam

The Rodman steam pre-expander, developed by the Koppers Co., makes it possible to manufacture expandable polystyrene products of much lower density than has previously been practical. The beads are partly expanded in the pre-expander, then introduced to the molding equipment where final expansion and forming occur. The pre-expander consists essentially of a cylindrical chamber into which the expandable beads are fed continuously with live steam. Circulation is provided by a paddle agitator. It is expected that the new equipment will be used in making modular sandwich panels for buildings and other structures. Licensed makers of the Rodman pre-expander are: *F. F. Slocomb Co., 1401 Poplar, Wilmington, Del.,* and *Artisan Metal Products, Inc., 69 Pond St., Waltham 54, Mass.*

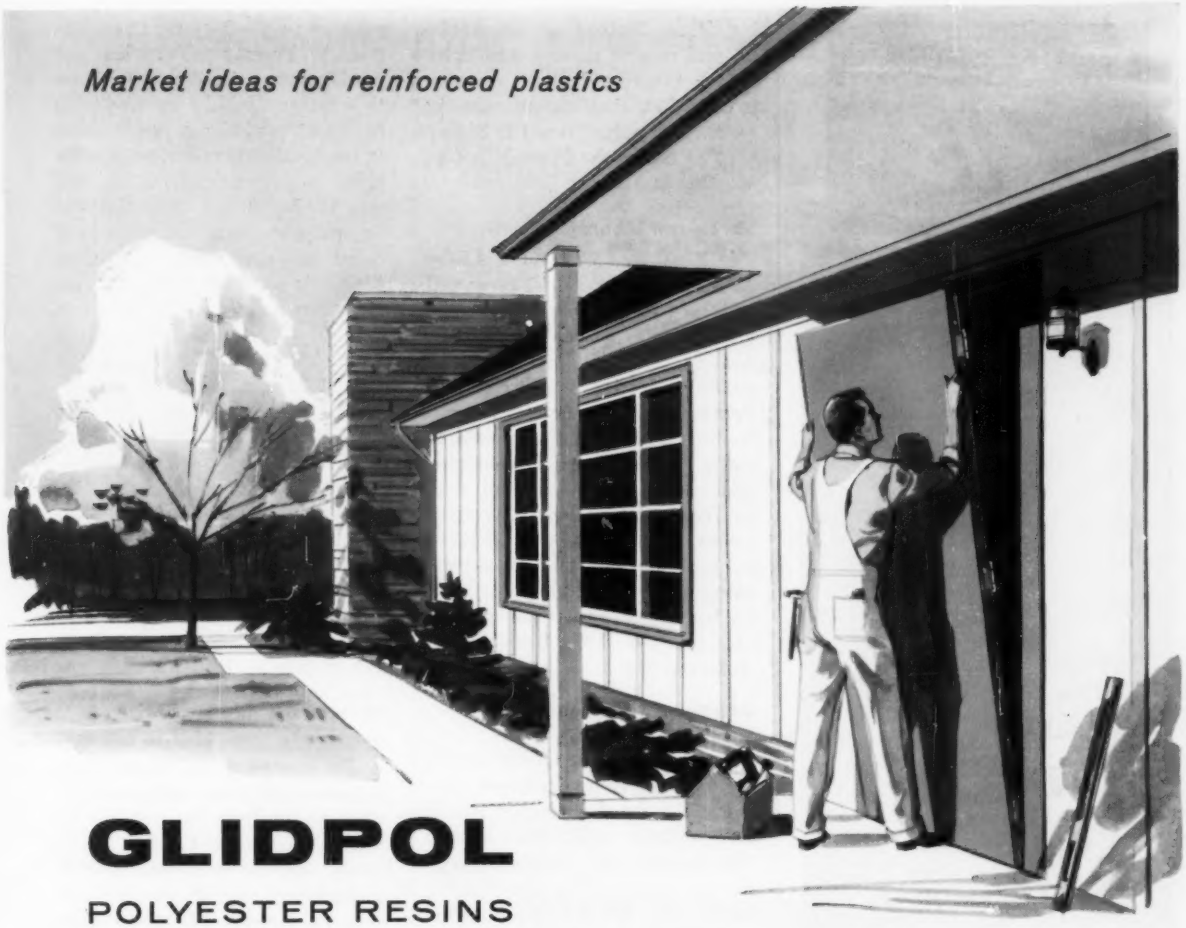
Foam cut-off machine

Continuous foam slab may be cut to predetermined lengths with the Femco automatic cut-off machine. Lengths from 6 to 60 ft. may be cut by this machine, which has been tailored to fit existing conveyor systems. Cut is made by a saw that moves along as it cuts, insuring an accurately vertical end surface. *Falls Engineering and Machine Co., Cuyahoga Falls, Ohio.*

Fast 6-oz. injection machine

The HPM Model 200-H-6/8 dry-cycles in 5 sec. at full stroke (15 in.) and offers an injection speed of 675 cu. in./min. Driven by a 30-hp. motor, the hydraulic system develops 200 tons of clamp-

Market ideas for reinforced plastics



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ing force. Platens are 26 by 26 in., will receive molds up to 15 by 26 in.; greatest daylight opening is 25 inches. Plasticating capacity (with G-P polystyrene) is 80 lb./hr. *The Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.*

Three-roll laboratory mill

The Ross No. 52LC is a 4.5-by 10-in. mill in which all three roll axes are in the same horizontal plane. Center roll can be fixed or floating, and all three can be quickly released for fast cleaning. Features include: one-piece cast frame, helical gears, oversized roller bearings, quick-removing end plates. Stainless steel rolls and two-speed motor are optional extras. Housing encloses all moving parts but the rolls. An adjustable, pivoted product-receptacle holder is provided. *Charles Ross and Son Co., 148 Classon Ave., Brooklyn 5, N.Y.*

Grinder attachment returns scrap

The Loadamatic, available on the Marvel series granulators, replaces the usual collection bin. A low-pressure pneumatic system lifts the granules through a pipe (in the fashion of familiar hopper loaders) to the molding machine or extruder hopper. Rates range from 75 to 400 p.p.h. with the several models. *Ball & Jewell, Inc., 24 Franklin St., Brooklyn 22, N.Y.*

Polyethylene film treater

The Aetna film treater, operating at 17,000 v. on 60 cycles, offers some interesting performance and safety features. Film is treated by passing it over a bare stainless drum (not furnished). The upper half of this drum is surrounded by lengthwise-oriented electrodes encased in glass tubes. (See diagram.) Twenty electrodes are used on an 8-in.-diameter drum to treat any widths up to 42 in.; for greater widths, a larger drum is used. Clearance between glass tubes and drums is 1/16 in., and any thickness less than this can be treated without adjustment of drum or electrodes. The glass dielectric and the electrodes inside them enjoy long, trouble-free life. Treating rates depend on resin formulation, but range up to 100 ft./min., while power required is about 500 v.-a. for each 100 sq. ft./min. treated. Larger drums may be used for higher treating rates. Cabinet is safety-interlocked, with circuit breaker rather than fuse. Since toxic ozone is formed by electric discharge, good ventilation is essential. *Aetna Electronic Corp., 207 Stonehinge Lane, Carle Place, L.I., N.Y.*

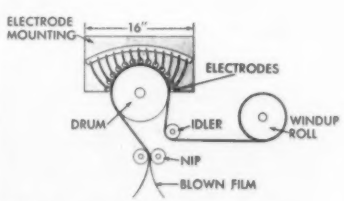


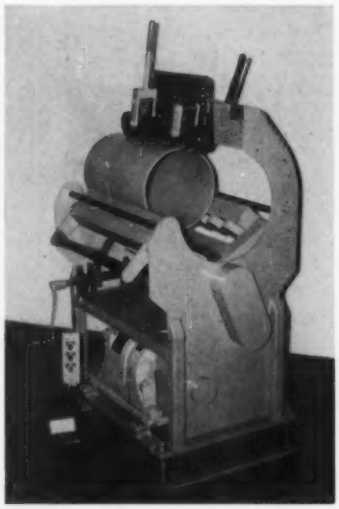
Diagram of Aetna Electronic film treater, showing location of the various parts

Marker for tubular parts

The Model 86A printer is especially designed to mark long tubular production parts such as pipe and tubing ranging in diameter from 0.5 to 4 inches. Maximum imprint area is 1.8 in. lengthwise and 2 in. circumferentially, depending on tube size. Die rolls can be furnished by the machine maker. The 86A can be used as an automatic "in-the-line" unit or as a separately controlled machine. Width and length are 100 and 36 in. respectively, while height is at the option of the customer. Up to 30 pieces per min. can be imprinted. *Markem Machine Co., Keene 77, N.H.*

Pipe take-off

The Model 600-4 pipe puller can be side-loaded and is adaptable to any size plastic pipe, tubing, or rod between ⅛ in. and 6 inches. An unusual feature is a single toggle-lever release, permitting rapid loading or unloading of pipe. Three sets of rollers are used, spaced equally around the pipe. Two sets support and pull the pipe, while the third set floats on top of the pipe or is locked in place to exert pressure on the driving rollers. Each roller set consists of five neoprene-covered rollers 4 in. in diameter and 1 in. wide. The driven sets are powered



Al-Be Industries pipe puller can accommodate plastic pipe, tube, and rod between ⅛ and 6-in. dia.

by a ½-hp. U.S. Varidrive that can deliver lineal speeds from 3 in./min. to 20 ft./min. Over-all dimensions are 54 in. high, 26 in. long, 22 in. wide. *Al-Be Industries, 6101 Clara St., Bell Gardens, Calif.*

Parting agent for RP

Lunn-Lease is a sprayable, film-forming parting agent with many desirable qualities for reinforced molding. Some of these are: wets waxed surfaces, dries fast and completely, forms tough elastic film, is completely unreactive with resins, is fire-resistant. It is satisfactory for molding phenolics, polyesters, and epoxies. This parting agent was developed and long used in production by the custom reinforced molding firm that is now marketing it. *Lunn Laminates, Inc., Huntington Station, N.Y.*

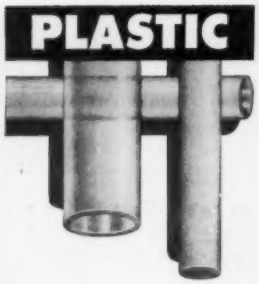
DC motor speed controls

Speed variators for d.-c. motors employ silicon rectifiers, have no tubes or rotating parts. They are available for single- and three-phase inputs of from ⅙ to 15 hp. Controllers provide continuous speed variation from zero to maximum. Over-all efficiency is at least 95% and voltage drop is so small that constant-torque characteristic is maintained. *Power Control Co., 71 Okner Pkwy., Livingston, N. J.*

More and more producers throughout Industry are specifying

Jessall®

EXTRUDED ROD and TUBING



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- CELLULOSICS
- ACRYLICS
- POLYETHYLENE
- POLYSTYRENE
- VINYL

MANY USES . . .

Jessall's thermoplastic products can be used under a wide variety of conditions such as high and low temperatures, acids and alkalis, abrasion, etc. where other materials are not satisfactory.

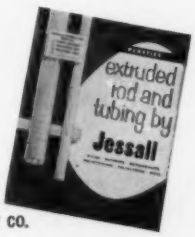
IMPROVE DESIGN AND CUT COSTS . . .

These products offer many advantages. Lightness, resistance to corrosion, good machinability, durability and other qualities present opportunities to improve design, cut costs, and lengthen service life.

QUICK DELIVERY . . .

Available in coils and standard lengths. Stocked in "clear" or "natural". Special sizes and colors made to order.

FREE! Bulletin No. 105 gives characteristics of 5 types of Rod and Tubing, dimensions and weights. Send for it today.



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rotary vacuum forming machine

Proven by 2 years' service

Brown Rotaries are now used by all major refrigerator manufacturers.

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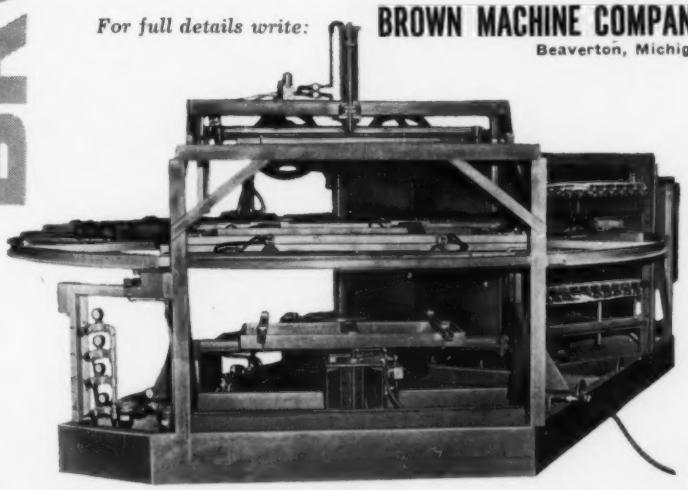

Books & Booklets

Write for these publications to the companies listed. Unless otherwise specified, they will be sent gratis to executives who request them on business stationery.

"Dangerous Properties of Industrial Materials"

By N. Irving Sax

Published in 1957 by Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. 1467 pages. Price: $22.50.

This new volume, a completely revised and enlarged edition of Sax's "Handbook of Dangerous Materials," provides a quick, single "safety" reference for those involved in the manufacture, use, handling, storing, or shipping of hazardous materials. Containing almost double the number of pages and almost double the amount of materials covered in the old volume, the book is divided into the following sections: Toxicology; Ventilation Control; Personnel Protection and Personnel Hygiene; Atmospheric Pollution; Radiation Hazards; Industrial Fire Protection; Storage and Handling of Hazardous Materials; Reactor Safeguards; Allergic Disease in Industry; General Chemicals; Shipping Regulations; and Index to Synonyms.

"Fasteners Handbook"

By Julius Soled

Published in 1957 by Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. 430 pages. Price: $12.50.

A discussion of mechanical methods of fastening (adhesive methods are not discussed), with detailed information on standard and proprietary fasteners from all manufacturers, including many specialized fasteners developed since World War II. Among the latter are all-nylon screws, hex nuts, and washers; ethyl cellulose screw anchors; Heli-Coil inserts and screw-lock inserts for use with plastics; metal fasteners for plastics and plastics fasteners for metals and other materials; etc. The book relates the actual use of fasteners in one industry to those of another, thus providing concrete examples of money-saving applications, and points out the values of many less known but equally valuable fasteners.

"Encyclopedia of American Associations," "Supplements I and II"

Encyclopedia published in 1956, Supplements in 1957 by Gale Research Co., 1116 Book Tower, Detroit 26, Mich. 401 pages. Price: $15.00

A total of 5947 organizations are described in the directory and supplements. Included are 2590 trade, agricultural, and government affairs organizations; 289 scientific and engineering; 683 educational and social welfare; 347 fraternal and general; 302 health and medical; 201 labor unions; and 1535 chambers of commerce. Each listing includes national headquarters, executive secretary, number of members, founding date, and a brief description of activities and purposes. A section in the supplement provides a subject index with listings in 50 topical and functional classifications.

Copper-clad laminates. Design suggestions for printed circuits using copper-clad plastic laminates. Circuit design, provisions for solder fillets, insertion of eyelets and lugs, and assembly of components are covered. Catalog No. 20. 4 pages. *The Richardson Co., 2777 Lake St., Melrose Park, Ill.*

Saws and cutters. Catalog CT-100, "Huther Bros. Tungsten Tipped Saws and Cutters," describes circular saws, groovers, and cutters used in plastics fabrication and wood working. 12 pages. *Huther Bros. Saw Mfg. Co., Inc., 1290 University Ave., Rochester 7, N. Y.*

Injection molding compounds. Electrical, physical, and chemical properties of Fiberfil glass-reinforced nylon and polystyrene injection molding compounds together with complete price data. 8 pages. *Fiberfil, Inc., Fox Farm Rd., Warsaw, Ind.*

O-ring seals. Tables, charts, and other data on the design and application of synthetic rubber O-ring seals. 160 pages. *Parker Appliance Co., Rubber Products Div., 17325 Euclid Ave., Cleveland 12, Ohio.*

Spray equipment manual. Full parts list and general information on installation, operation, and maintenance. Replaces previous manuals which were kept current by periodic replacement pages. Price: $2.50. 405 pages. *The DeVilbiss Co., Toledo, Ohio.*

Lighting systems. Diagrams, specifications, and engineering and other data are given for seven types of luminous ceilings available from stock parts. Specially designed track systems can be installed with minimum labor. 8 pages. *Luminous Ceilings Inc., 2500 W. North Ave., Chicago 47, Ill.*

Epoxy plasticizers. Physical properties, compatabilities, heat stability, performance data, and other technical details are given for Admex epoxy plasticizers for vinyl resins. 28 pages. *Archer-Daniels-Midland Co., 700 Investors Bldg., Minneapolis 2, Minn.*

Nylon. Product number, characteristics, form of processing, typical applications, and prices are given for various grades of nylon. Price list SN-2. 4 pages. *Spencer Chemical Co., Dwight Bldg., Kansas City 5, Mo.*

Aluminum silicate pigments. Characteristics and applications as plastics fillers of aluminum silicate pigments (ASP's)—white aluminum silicate crystals of selected particle size that have been

FAST CURING . . . GENERAL PURPOSE

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PHENOLIC MOLDING COMPOUND

A woodflour-filled, two-step compound with excellent electrical properties, superior surface finish, and universal molding qualities.

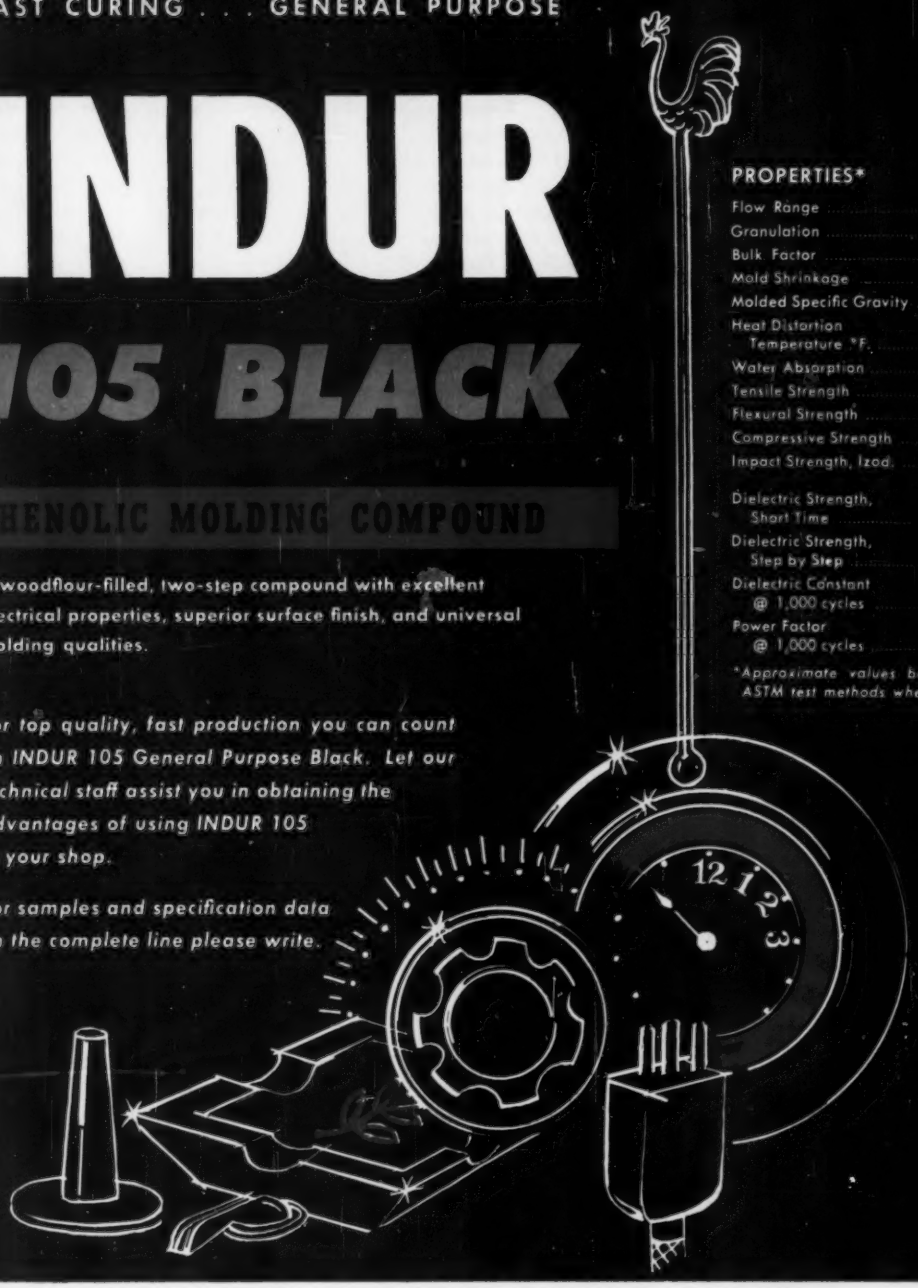
For top quality, fast production you can count on INDUR 105 General Purpose Black. Let our technical staff assist you in obtaining the advantages of using INDUR 105 in your shop.

For samples and specification data on the complete line please write.

PROPERTIES*

Flow Range	Soft to Hard
Granulation	16 Mesh
Bulk Factor	2.3-2.7
Mold Shrinkage	0.005-0.007 in./in
Molded Specific Gravity	1.35-1.37
Heat Distortion Temperature °F.	290 min.
Water Absorption	0.5% max.
Tensile Strength	6,500 psi min.
Flexural Strength	9,000 psi min.
Compressive Strength	30,000 psi min.
Impact Strength, Izod.	0.30 ft. lbs./in. of notch, min.
Dielectric Strength, Short Time	300 volts/mil, min.
Dielectric Strength, Step by Step	200 volts/mil, min.
Dielectric Constant @ 1,000 cycles	7.0 max.
Power Factor @ 1,000 cycles	0.07 max.

Approximate values based on standard ASTM test methods wherever possible.



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How

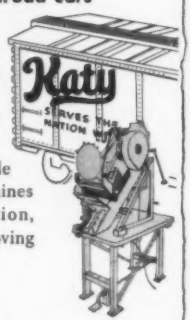
MARKEM

solves typical problems in

IDENTIFICATION and DECORATION

marking model railroad cars

Several leading U. S. toy makers had used decals (costly both to buy and apply) on their replica model train cars. Authentic imprints are now made by Markem 25A machines—speeding production, lowering costs, improving looks.



imprinting food container lids

Bothered by the cost, delivery and inventory problems caused by short run lid printing jobs done "outside", a food retailer now prints the lids he needs as he needs them, using several 45ABE machines. Supply now matches demand, with the right marking method.

screen process printing: basketballs . . . to candles

Markem 90S and 106S machines "mechanize" screen process printing, giving fine detail yet heavy coverage. Surfaces and shapes now being marked range from basketballs, candles and 3-color instrument dials to play shoes, plastic bottles and billfolds. Excellent for many jobs—the *only* method for some.

These are typical of the thousands of marking problems Markem solves every year for all types of industries. The benefits of 46 years of experience are applied to every job—and can be to yours. Write Markem Machine Company, Keene 20, N. H.

MARKEM

process-engineered to remove moisture, sand, mica, water-soluble salts, and hard particles. Bulletin 225. 4 pages. *Minerals & Chemicals Corp., of America, Essex Tpke., Menlo Park, N. J.*

"Formica Commercial Interiors" discusses wall treatments and illustrates recent commercial buildings where Formica laminated plastics have been used for fixtures and "on-the-job" wall applications. 8 pages. *Formica Corp., 4614 Spring Grove Ave., Cincinnati 32, Ohio.*

Asbestos fibers. "Amveco Asbestos Fibers for Reinforcement of Plastics" gives formulations, physical properties, and applications. Prices are included. 5 pages. *World Commerce Corp., S. A., Asbestos Div., 445 Park Ave., New York 22, N. Y.*

Impregnating resins. Description of Eccoseal impregnating resins for electronic components, including materials for transformers, coils, capacitors, and circuits. 10 pages. *Emerson & Cuming, Inc., 869 Washington St., Canton, Mass.*

High-impact thermoplastic resin. Description and suggested applications of Cycolac high-impact thermoplastic resin. 12 pages. *Marbon Chemical, 7165 W. Chicago Ave., Gary, Ind.*

Moistening control. Description of the Web Conditioner which controls the addition of moisture to plastics, paper, paper board, textiles, leather, etc. Typical applications are illustrated. 8 pages. *J. O. Ross Engineering Corp., 444 Madison Ave., New York, N. Y.*

Urethane concrete coatings. Technical data on formulation, application, and properties of urethane coatings made with Mondur CB and Multron resins for use on concrete. Bulletin C-4. 9 pages. *Mobay Chemical Co., St. Louis 4, Mo.*

Industrial parts. Data on more than 2000 small injection molded and extruded plastics parts—closures, wire tips, bumpers, spacers, rollers, builders' hardware, etc.—in nylon, polyethylene, butyrate, and vinyl. Material specification tables are included. Catalog 500A. 60 pages. *Pipco International Corp., 1731 Stanford St., Santa Monica, Calif.*

Chemical processing equipment. Latest types of mixing, grinding, and dispersing equipment for all types of applications. Brochure 3C. 4 pages. *Charles Ross & Son Co., 148 Classon Ave., Brooklyn 5, N. Y.*

Bulk materials handling. Description of the Tote System in detail, explaining automatic filling and discharge systems, and giving specification on equipment construction. 20 pages. *Tote System, Inc., Beatrice, Neb.*

Vinyl sheeting. Specimen color booklet of Weldron vinyl sheeting, a pliable upholstery material with a knitted jersey backing with color and fabric welded to the underside of the vinyl. 4 pages. *The Barash Co., a Div. of U. S. Plywood Corp., 122 Fifth Ave., New York, N. Y.*

Silicone molding compounds. Charts, graphs, and field examples and a discussion of the low thermal conductivity, superior electrical properties, and high temperature strength-to-weight ratio of silicone molding compounds. Code 7-603. 4 pages. *Dow Corning Corp., Midland, Mich.*

"Color Sells!—Yes," Bulletin No. 262, details the successful uses to which Macbeth Daylighting has been put in industries where the critical viewing or matching of colors to standards is a problem. 4 pages. *Macbeth Daylighting Corp., Newburgh, N. Y.*

Tapes. Description and illustrations of the use of pressure sensitive tapes under difficult conditions, with actual tape samples. File 57TT1. 4 pages. *Tropical Tape Div., 899 Country Club Circle, Ft. Lauderdale, Fla.*

Hydroquinone derivative. Typical properties and reactions of 2,5-dihydroxybenzoquinone, a hydroquinone derivative suggested

THE NATCO 400

a wastebasket every 30 seconds

Rejects less than 1%.

Color change in 10 shots.

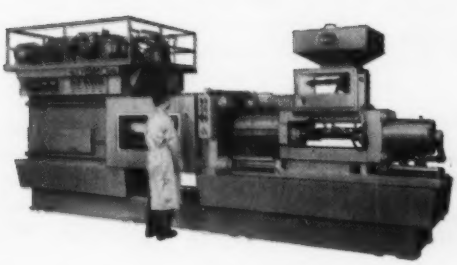
Dependable "around the clock" production.

That's the record made by the new 28 ounce Natco 400 at Bluebird Plastics—Coshocton, Ohio. And that's not all! On this 16 ounce shot, dry coloring is excellent, finish is far above average and Bluebird's customer is happy too!

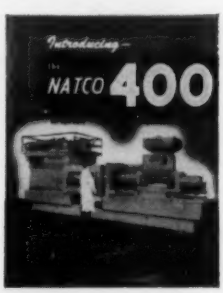
Whether you mold polyethylene housewares or not, your plastics job will run better in a new Natco. Now, for the first time you can get speed plus accurate and dependable controls.

Natco's "patented" shockless hydraulic system eliminates high peak pressures, which break pipes and cause expensive downtime.

Yes, there's a reason why molders are talking about the new Natco. Why don't you investigate its cost saving features? Sizes range from 12 to 85 ounces. Write today for complete information.



Ask for free copy of Bulletin 4001 describing the new Natco 400.



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PLASTICS MACHINERY DIVISION

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FOR OVER FIFTY YEARS, DESIGNERS AND BUILDERS OF AUTOMATIC PRODUCTION MACHINERY

BLACK AS A BEAR... AND MUCH SAFER!

When black grabs hold of your nylon moldings, does the compound sap their strength? It's a common complaint... but here's good news: Cyanamid has developed two dyes especially for nylon blacks that won't weaken, won't cause brittleness:

CALCO® Nigrosine Base Z-3 – recommended for precision monofilament type extrusions.
CALCO® Induline Base Z5G – for nylon moldings of all shapes and sizes.

Both yield an authentic BLACK. Both are excellent money values, too. More and more products – from casters to fountain pen barrels – are made from tough nylon plastic today. To increase your share of this market, specify these deeper blacks, safer blacks – by Cyanamid.

Calco
The Symbol of Quality Dyes

CYANAMID

AMERICAN CYANAMID COMPANY, DYES DEPARTMENT, BOUND BROOK, N. J.

for investigation, among other things, as a polymerization inhibitor and an intermediate for polymers and dyes. 2 pages. *Eastman Chemical Products, Inc., Kingsport, Tenn.*

Company services. Machine design and fabrication, equipment layout, equipment and material procurement, equipment installation, training of personnel, and engineering consultation services are described, as is also Digitork, a new tool for use in precision control and power positioning. 12 pages. *Contract Engineering Div., The Teller Co., Butler, Pa.*

Depreciation. Two booklets on the subject of depreciation—"Effect of the New Tax Depreciation Methods on the Earnings of Depreciable Assets," 33 pages; and, "Two Views on Depreciation," 20 pages—are available from *National Automatic Tool Co., Inc., Richmond, Ind.*

Solvent. Properties, specifications, shipping information, solubilities, constant-boiling mixtures, and applications of butanol *n*-butyl alcohol. Bulletin F-7909. 12 pages. *Union Carbide Chemicals Co., 30 E. 42nd St., New York 17, N. Y.*

Standards. Discussion of the American Standards Association and how industry profits by having the 1687 American Standards used throughout the nation. List of A.S.A. Member-Bodies and Associate members is included. 32 pages. *American Standards Assn., Inc., 70 E. 45th St., New York 17, N. Y.*

Plastics protectors. Description of over 200 different plastics protectors—plugs and caps for protecting internal and external threaded parts, ends of tubes, etc. —molded from rigid acetate and flexible vinyl. Bulletin P 5708. 18 pages. *S. S. White Plastics Div., 10 E. 40th St., New York 16, N. Y.*

Unplasticized PVC. Survey of the properties of unplasticized PVC and copolymers, presented in four parts: properties of polymers, sheet, and tube; chemical resistance of unplasticized PVC,

compounding techniques, methods of extruding tube, preparation of sheet materials; welding and allied fabrication techniques; and low-pressure molding techniques. "Unplasticized PVC as a Constructional Material in Chemical Engineering." 23 pages. *British Geon Ltd., Devonshire House, Picadilly, London W. 1., England.*

Corrections

Estafoam, a rigid plastic foam developed by Vanguard Products, Newark, N.J., was stated as being "related to urethane" in MODERN PLASTICS' October article on rigid foam. We have been informed by Vanguard Products that Estafoam bears no chemical relation to urethane foam; that its composition is essentially 100% unsaturated polyester, and that it employs a cross-linking monomer such as styrene—not isocyanate. Since Estafoam is based on lower-priced raw materials than urethane foam, Vanguard indicates its product, when available in commercial quantities, will sell at a much lower price—in the range of expandable styrene foam.

E. L. Colichman, who co-authored "Effect of gamma radiation on epoxy plastics" (MODERN PLASTICS 35, 180, Oct. 1957), was affiliated with Atomics International, a Div. of North American Aviation, Inc., when the article was written. However, he is now and was at time of publication head of the Propellants Group, Guided Missile Research Div., The Ramo-Woolridge Corp., Los Angeles, Calif.

The following corrections are noted for the article "World trade in plastics" (MODERN PLASTICS 35, Oct. 1957): Concerning the construction of polyethylene capacity in Japan (p. 103), all polyethylene producers in Japan are strictly Japanese enterprises, although the processes used are licensed from I.C.I., Phillips, and Ziegler; Canadian Industries Ltd. (p. 104) is an independent company, *not* jointly owned by I.C.I. and Du Pont; vinyl imports into Korea (p. 105) were 1.8 million lb. in 1956, and not 18 million, as stated in the article; Canadian Resins & Chemicals Ltd. is located at Shawinigan Falls, Quebec, Canada (p. 108).

UNIQUE *asbestos fiber for phenolics, polyesters*

POWMINCO ASBESTOS

POWMINCO ASBESTOS is the *only completely fiberized acid-resistant asbestos fiber in the United States.*

Made exclusively by the Powhatan Mining Company, it is now widely used as a filler and an absorbent and extender in phenolic and polyester resins.

Proved Acid-Resistant

POWMINCO ASBESTOS, practically inert (95% insoluble), is unaffected by as much as four hours boiling in concentrated hydrochloric acid. It is this quality that gives it a distinct advantage over ordinary chrysolite fiber in molding compounds (such as phenolics) that require an acid catalyst, and in casting resins.

Because it contains so little water (it's an anhydrous magnesium silicate), unusually low shrinkage results when POWMINCO ASBESTOS is used in molding and tooling operations.

Offers Exceptional Advantages

Excellent heat resistance, very high dielectric strength and extremely low magnetic iron plus high absorption, easy "blendability" and *low cost* conclusively guarantee POWMINCO ASBESTOS as the finest filler you can buy.

For working samples (for any resin), simply write us on your letterhead. No charge or obligation.

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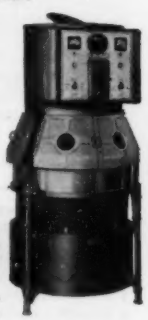
Your fast way of pre-determining the weathering qualities of a Plastic is in the ATLAS WEATHER-OMETER®

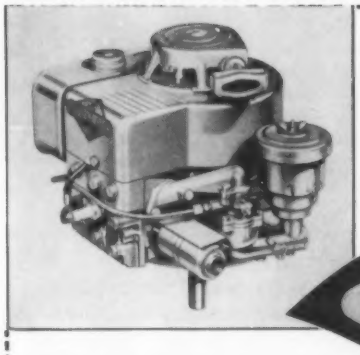
Test for resistance to sunlight, moisture, and thermal shock.
Results are accurate and reliable and can be reproduced precisely over and over again.
The Weather-Ometer furnishes a yard stick to measure the improved quality of a plastic in development and to maintain a standard of quality in production.
Automatic control of light, moisture, and temperature, can be set for repeating cycles according to the test program selected. A year of destructive weathering can be reduced to a few weeks of testing in the Weather-Ometer.



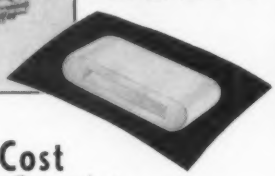
For Color Fastness only — use the Atlas Fade-Ometer®. Fully automatic in operation.

Write for technical information and recommendations for your particular problem.

ATLAS ELECTRIC DEVICES CO., 4114 N. Ravenswood Ave., Chicago 13, Illinois



NO MOLD COST!



Reduced Unit Cost

on your initial run will effect savings for you that could very easily cover the cost of mold.

That is actually being done on many jobs similar to the starter pulley bumper (shown above) that SINKO molded for use on the Briggs and Stratton engine illustrated. Dupont ZYTEL was the plastic used because of its ability to resist wear, its quiet operation, and self-lubricating qualities.

Call on us when you're in need of Plastic Molded Parts . . . we'll produce them for you, accurately, speedily, and economically!

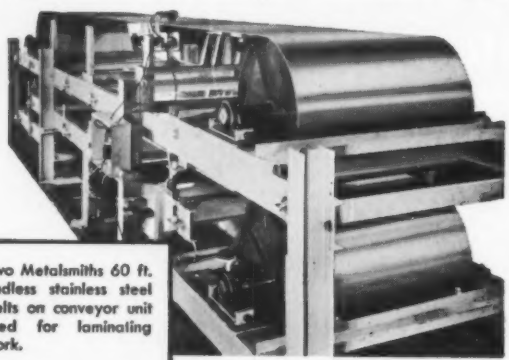
WE MOLD ALL THERMOPLASTICS—4 to 100 oz.

SINKO MFG. & TOOL CO.
7310 W. WILSON AVE. • CHICAGO 31, ILLINOIS

Offices in principal cities throughout the United States.

ENDLESS STAINLESS STEEL BELTS

Speed up Cooling — Setting — Conditioning of Sheets—film—coatings—laminated work



Two Metalsmiths 60 ft. endless stainless steel belts on conveyor unit used for laminating work.

Automatic Contact Glass

Polished stainless steel belt provides high gloss as materials move through cooling and conditioning.

Investigate continuous belt-processing for increased production and lower costs. One-piece, polished or unpolished, in any length and extra-wide sizes. Stainless steel (18-8) provides dense, corrosion-free surface. Width and camber controlled. Consult our engineers. Metalsmiths, 558 White St., Orange, N. J.

METALSMITHS STAINLESS STEEL ENDLESS CONVEYOR BELTS

mp Plastics

Production and sales in 1000 lb.* for July and August 1957

Materials	*Total p'd'n first 8 mos. of 1957*	*Total sales first 8 mos. of 1957*
Cellulose plastics:[a]		
Cellulose acetate and mixed ester		
Sheets under 0.003 gage	12,822	12,175
Sheets, 0.003 gage and over	11,711	11,447
All other sheets, rods, tubes	4,527	4,473
Molding, extrusion materials	59,387	58,442
Nitrocellulose sheets, rods, tubes	2,775	2,799
Other cellulose plastics	3,714	3,177
Phenolic and other tar-acid resins:		
Molding materials[a]	117,973	116,682
Bonding and adhesive resins for:		
Laminating (except plywood)	38,352	31,082
Coated and bonded abrasives	11,226	10,850
Thermal insulation	35,228	34,622
Plywood	30,905	23,432
All other bonding uses*	36,453	34,512
Protective-coating resins	19,802	16,811
Resins for all other uses	25,104	21,171
Urea and melamine resins:		
Textile-treating resins	23,434	22,965
Paper-treating resins	17,243	15,948
Bonding and adhesive resins for:		
Plywood	61,997	60,103
All other bonding and adhesive uses, including laminating	20,453	18,952
Protective-coating resins	23,857	18,044
Resins for all other uses, including molding	58,912	59,384
Styrene resins:		
Molding materials[a]	270,517	263,821
Protective-coating resins	54,474	52,734
Resins for all other uses	96,150	79,449
Vinyl resins, total[b]	545,424	497,332
Polyvinyl chloride and copolymer resins (50% or more polyvinyl chloride) for:		
Film (resin content)		60,615
Sheeting (resin content)		36,899
Molding and extrusion (resin content)		144,395
Textile and paper treating and coating (resin content)[c]		43,030
Flooring (resin content)		54,315
Protective coatings (resin content)		22,911
All other uses (resin content)		30,411
All other vinyl resins for:		
Adhesives (resin content)		28,464
All other uses (resin content)		76,316
Coumarone-indene and petroleum polymer resin	168,305	169,058
Polyester resins	63,279	57,399
Polyethylene resins	436,524	419,041
Miscellaneous:		
Molding materials[a, d]	31,109	31,072
Protective-coating resins[e]	8,804	4,260
Resins for all other uses[f]	87,622	81,258

*Dry basis designated unless otherwise specified. †Revised. ‡Partially estimated. ¶Includes friction materials.
[a]Includes fillers, plasticizers, and extenders. [b]Production statistics by uses are not representative, as end use may not be known at the time of manufacture. Therefore, only statistics on total production

Production

From statistics compiled by the U. S. Tariff Commission

July		August	
Production	*Sales*	*Production*	*Sales*
1,390	1,351	1,600	1,562
1,009	1,257	1,570	1,511
472	513	410	413
6,621	6,388	7,200	7,739
233	299	318	300
341	262	511	465
12,025	11,858	12,984	15,710
4,099	3,500	3,542	4,234
965	1,117	1,328	1,371
4,699	4,874	5,243	5,216
3,579	2,870	3,859	2,931
4,985	4,445	4,648	4,764
†1,635	†1,535	2,257	2,178
2,255	1,958	3,440	2,316
1,864	2,030	2,702	2,839
1,901	1,870	1,864	1,950
6,715	6,866	8,164	7,537
2,556	2,467	3,339	2,808
2,527	1,785	2,639	2,050
5,020	6,508	7,419	7,435
29,007	32,361	35,030	33,291
6,024	7,065	6,566	6,145
9,882	8,653	11,489	9,731
63,272	53,285	72,263	63,916
	6,342		7,121
	4,362		4,941
	14,340		17,962
	5,372		6,884
	6,030		7,553
	2,755		2,515
	2,872		4,252
	3,236		3,677
	7,976		9,011
21,603	20,713	23,513	23,448
7,209	6,826	7,336	7,081
55,357	50,582	58,349	55,340
3,834	3,518	3,555	4,061
1,032	565	1,213	505
10,594	9,516	11,758	12,019

are given. [c]Includes data for spreader and calendering-type resins. [d]Includes data for acrylic, nylon, and other molding materials. [e]Includes data for epichlorohydrin, acrylic, silicone, and other protective-coating resins. [f]Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.

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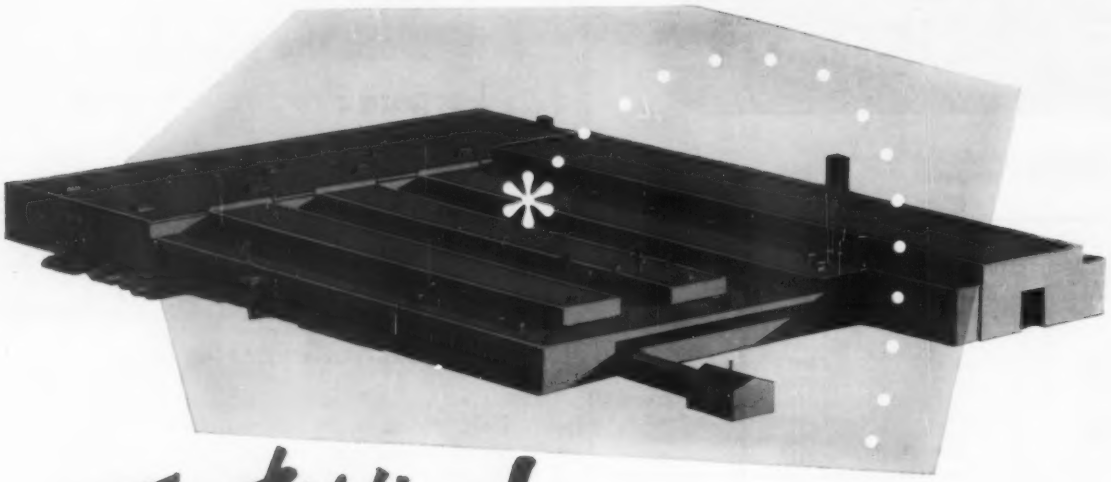

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7. Quality control
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10. Finishing and packaging
11. Decorative painting and imprinting
12. Paint and chemical storage
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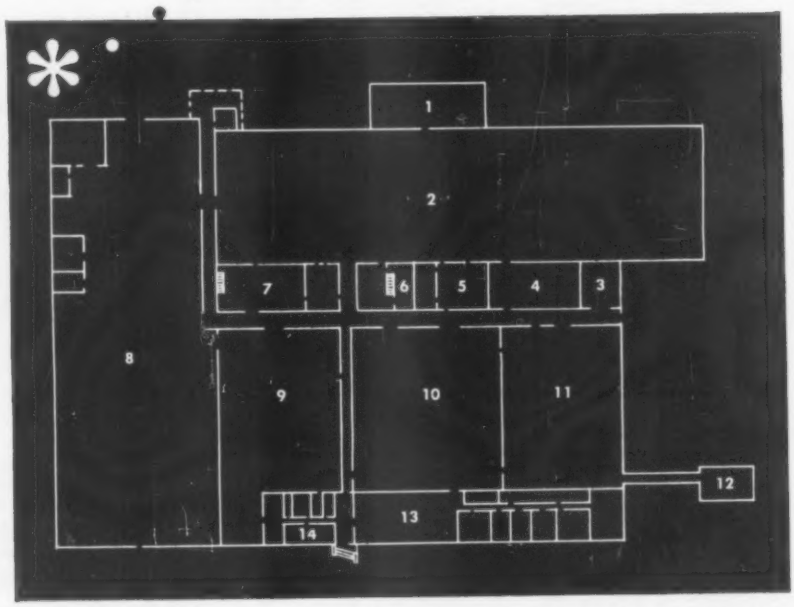

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Injection molders of thermoplastics

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Currency embedded in lid of cigarette box

Business men in a quandary as to year-end presents for employees and business acquaintances can add an unusual clear acrylic cigarette box to their list of gift suggestions. The boxes have lids in which are embedded real specimens of out-of-date paper currency.

Each box produced is a one-of-a-kind numismatic curiosity incorporating such erstwhile legal tender as Connecticut Colony currency, Confederate paper money, Jefferson Davis notes, and the like. Coin collectors pay between $5 to $50 per bill for such currency in the open market. The cigarette boxes retail from $6 to $10, depending on size.

Boxes and lids are separately compression molded and then hinged together. To embed the currency, the lid mold is partially filled with molding powder and the money positioned on top of the material; additional acrylic material is then added to fill the mold. The mold is closed, heat and pressure are applied, the assembly cooled, and the finished lid removed.

Boxes are offered in the following sizes (in.): 5½ by 4 by 1⅜; 4 by 3 by 1¼; 8¾ by 4⅛ by 1¼; and 8¾ by 4⅛ by 1¾.

Credits: Molded and marketed by Creative Plastics Corp., Stony Brook, Long Island, N. Y.; Lucite acrylic resin from Du Pont.

Compression molded acrylic boxes have authentic money embedded in their lids

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Gauges: .020 .030 .040 .050 .060

SHEETS Dimensions: 4′ x 8′

Gauges: 1/16″ 1/8″ 3/16″ 1/4″ 1/2″ 3/4″ 1″

SEIBERLING SEILON ETH-R

(High Density Polyethylene)

ROLLS Width 48″

Gauges: .020 .030 .040 .050 .060

SHEETS Dimensions: 4′ x 8′

Gauges: 1/16″ 1/8″ 3/16″ 1/4″

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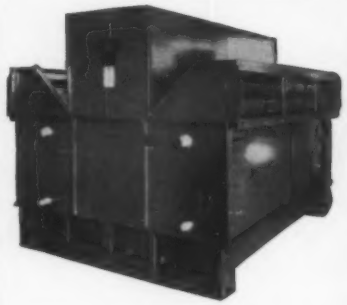

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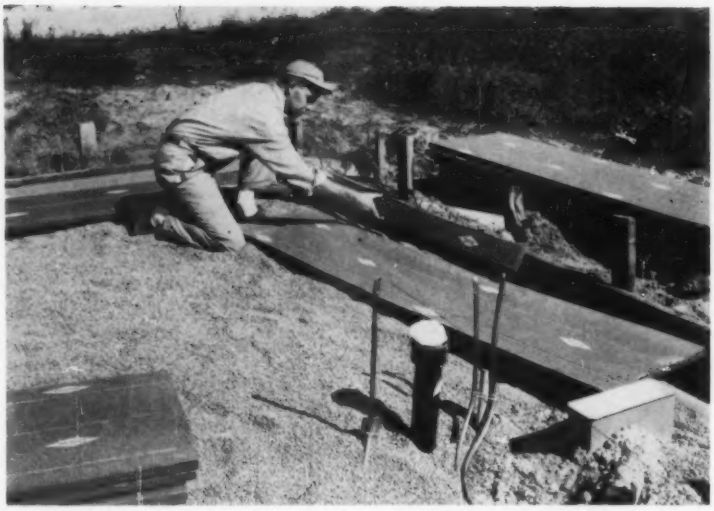


Eight widths, all different, can be snapped off this 24-in. width of Scorboard, a new perimeter and cavity wall insulating material developed by The Dow Chemical Co. Scorboard, uniformly black in color, performs like other prefoamed styrene planks, and offers the added advantage of its built-in labor saving feature

Snap-off foamed styrene board

A new version of Styrofoam with a built-in labor saving feature has been developed by The Dow Chemical Co. Designed as a perimeter and cavity wall insulating material for the construction industry, Scorbord is a black, smooth-surfaced board of expanded polystyrene measuring 2 by 8 ft., and 1 in. thick. Three prominent scores are cut the length of each board at the 3, 12, and 20 in. marks across its width. These slits, on both sides of the board, allow the installer to snap off widths of 3, 4, 8, 9, 12, 17, 20, and 21 in., or to use the board in its full 24 in. width. No tools are needed to break the board to width. The available selection of sizes should be ample for most standard foundation perimeters and cavity wall uses.

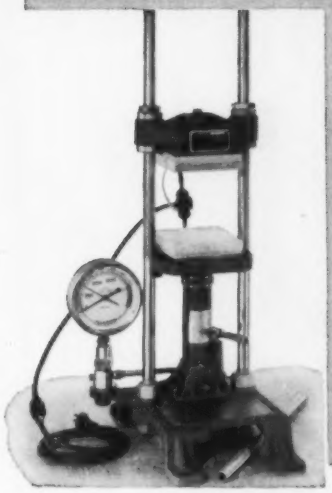
Tests of the new product have shown that labor savings of 50% can consistently be realized against competing forms of perimeter and cavity wall insulation, according to Dow.

Scorbord will be available at no increase in price over regular Styrofoam. Dow is presently building up a network of selected building materials suppliers who will distribute the product nationally.

Like other expanded styrene products, Scorbord is waterproof, rotproof, chemically resistant, has no food value for rodents or insects, and has enough structural strength to permit pouring of concrete slabs directly on top of the foam board after it is placed in position.

Scorings on both sides of new form of styrene insulating material permit on-the-job fabrication by hand, with no tools whatever needed. The wide range of available widths cover most applications. (Photos, The Dow Chemical Co.)

The CARVER LABORATORY PRESS



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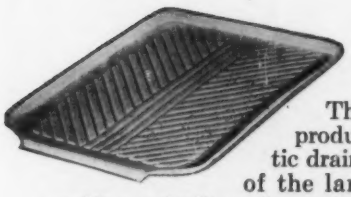

The mold which produced this plastic drainboard is one of the largest plastic molds ever built on the west coast. A block of CSM 2 was the steel used . . . obtained from local *Crucible warehouse stock*. L. D. Plastic Tool and Die Co., South Gate, California, built the mold for Alladin Plastics, Inc., Los Angeles.

CRUCIBLE CSM 2 was the choice for two big reasons—*quality* and *convenience*. Ultrasonic inspection of *every* piece, regardless of size, insures unvarying quality. And regular stocks of 205 different sizes of CSM 2, carried in Crucible warehouses, means *fast* delivery whether your application calls for a pound or several tons.

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Vinyl film welding chamber

The very low gas transmission rate of cast vinyl film has been put to practical use by the aircraft industry in the design of an easy-to-set-up, inert-gas enclosure in which to weld titanium jet-engine parts. Ordinarily, when titanium is welded in the presence of oxygen, impurities occur at the welded joint. By performing welding operations in a chamber filled with an inert gas, however, much of this danger can be eliminated.

The vinyl film welding tents are about 4 ft. high and 4 ft. in diameter. When welding titanium, the part is first placed in the tent and argon gas is piped in. This forces atmospheric air out through several small valves at the top of the tent. The slightly higher pressure of the argon gas keeps the tent inflated. Sleeves with attached gloves are built into the tent to provide the welder with ready access to the part and to prevent gas from escaping.

In addition to its low gas transmission rate, the vinyl film's toughness, light weight, transparency, and flexibility also contributed to the ultimate success of the application.

Credits: Fabricated for Pratt & Whitney Aircraft by Pioneer Valley Plastics Co., Chicopee, Mass., using Krene cast vinyl supplied by Bakelite Co.

Inert-gas enclosure fabricated of vinyl film is used when welding titanium parts. (Photo, Bakelite Co.)

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For polystyrene or acrylics, manufacturers the world over have found Schwartz Cleaners the most dependable in the field.

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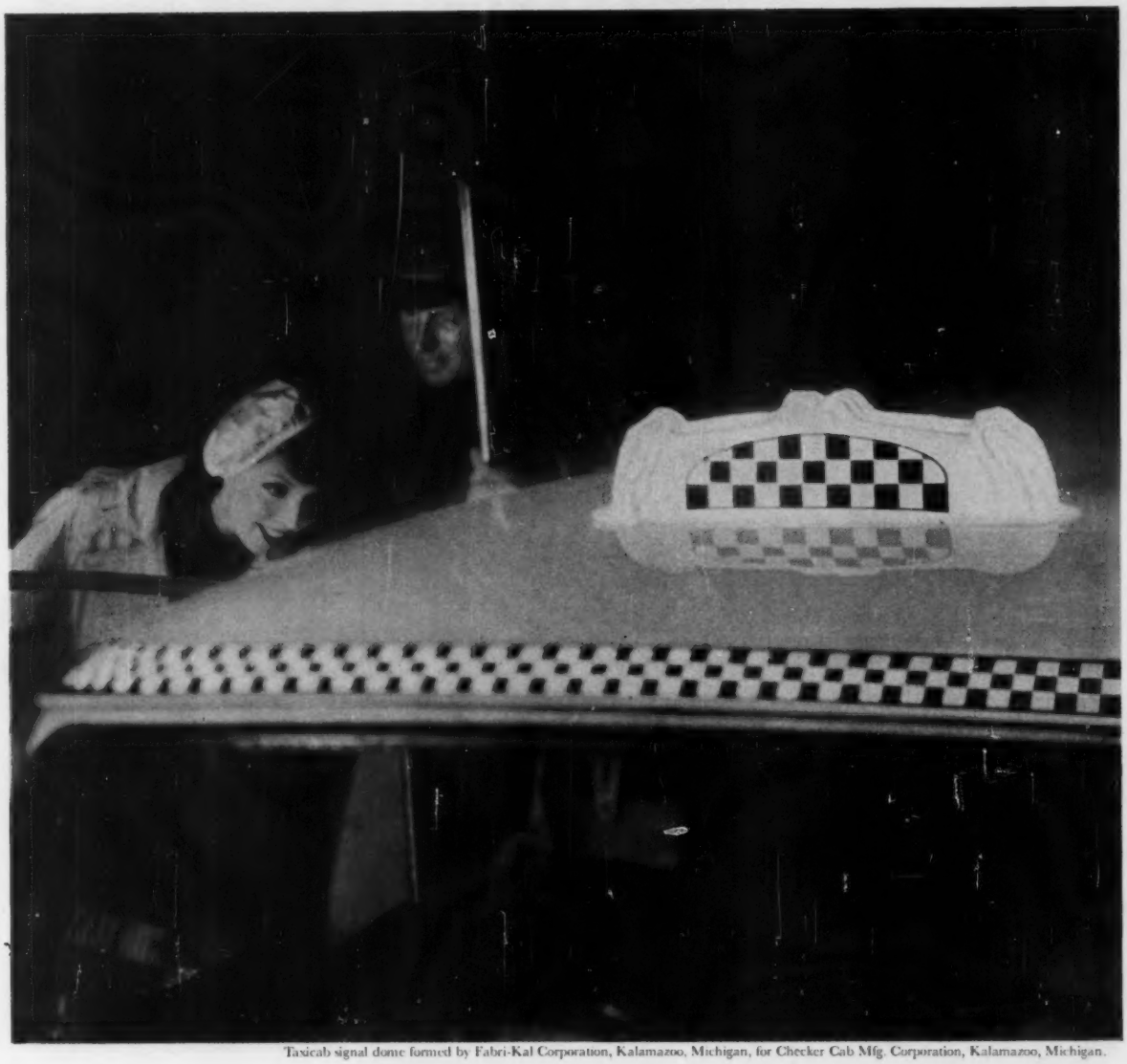

Taxicab signal dome formed by Fabri-Kal Corporation, Kalamazoo, Michigan, for Checker Cab Mfg. Corporation, Kalamazoo, Michigan.

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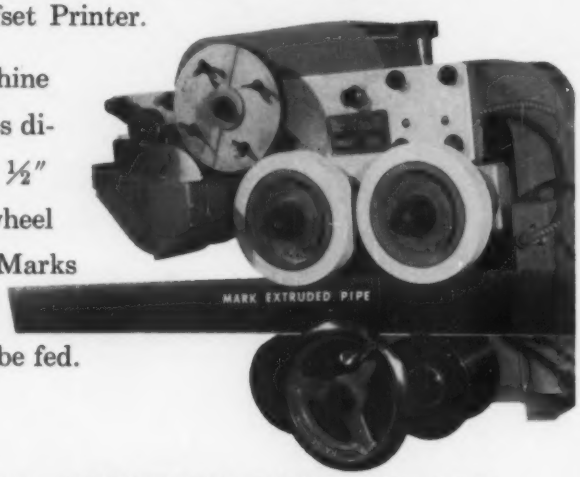

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Reinforced chalkboard

Lightweight, glare-free reinforced plastic chalkboards that will not crack, shatter, or peel in service are now available for school or business use.

Easily handled and installed because of its light weight, the new Staylite Chalkboard can be used with simple, inexpensive trimming materials and needs virtually no maintenance. The boards can be sawed or drilled on the job with ordinary tools. Besides installation and maintenance economies, original cost of the chalkboards is only about one-half that of other quality chalkboards, according to the manufacturer.

The Staylite product, made of polyester resin reinforced with fibrous glass, weighs about 8 oz./sq. ft. and is available in 4 by 8 ft.

panels. Colors are light green, grey, white, and dark green. Dark green is the most popular choice because of its glare-free quality and good contrast with white and colored chalks.

The writing quality and durability of the new chalkboard is said to be equal to that of higher-priced boards. In tests, the boards withstood over 50,000 passes of chalk and eraser. On erasure, the surface is said to leave no "ghosting."

Credits: Manufactured by Stahl Industries, Youngstown, Ohio, using Polylite polyester resin supplied by Reichhold Chemicals, Inc., White Plains, N.Y.

MARLEX* 50 POLYETHYLENE Makes Tough, Colorful Rope

Here is a brand new cordage material that is stimulating the interest of rope users everywhere! Filaments made from MARLEX 50 have a tensile strength varying from 50,000 to as high as 150,000 psi, according to diameter and draw-down.

MARLEX 50 polyethylene is a high-modulus material that produces filaments with excellent tenacity, superior resistance to moisture and chemicals, along with *low-temperature flexibility*. Applications are many and varied—from surgeons' sutures to tugboat hawsers.

Don't delay . . . get in touch with your MARLEX sales representative today. Ask him to demonstrate for you the advantages of this amazing new low-cost material.

MARLEX SALES SERVICE LABORATORY

This new Sales Service Lab in Bartlesville is completely equipped with latest processing machinery and research apparatus. Phillips experienced technical service staff will assist you in developing new products and processes using MARLEX plastics. Please make arrangements through your MARLEX sales service representative.

Rope made from this revolutionary new polyethylene actually *floats . . . does not absorb water!* Thus, there is no swelling and consequent strand structure deformation when used in marine and other outdoor applications. Strength, endurance, heat resistance and light weight of MARLEX 50 rope will add to its popularity.

Filament spinning section at the Sales Service Lab, where MARLEX plastics specialists are constantly evaluating new manufacturing techniques and applications for MARLEX 50 filaments. They have discovered that filament elongation of this new plastic can be varied by orientation during processing from 5% to 30%, adding greatly to its versatility as a material.

*MARLEX is a trademark for the Phillips family of olefin polymers

PLASTICS SALES DIVISION, PHILLIPS CHEMICAL COMPANY

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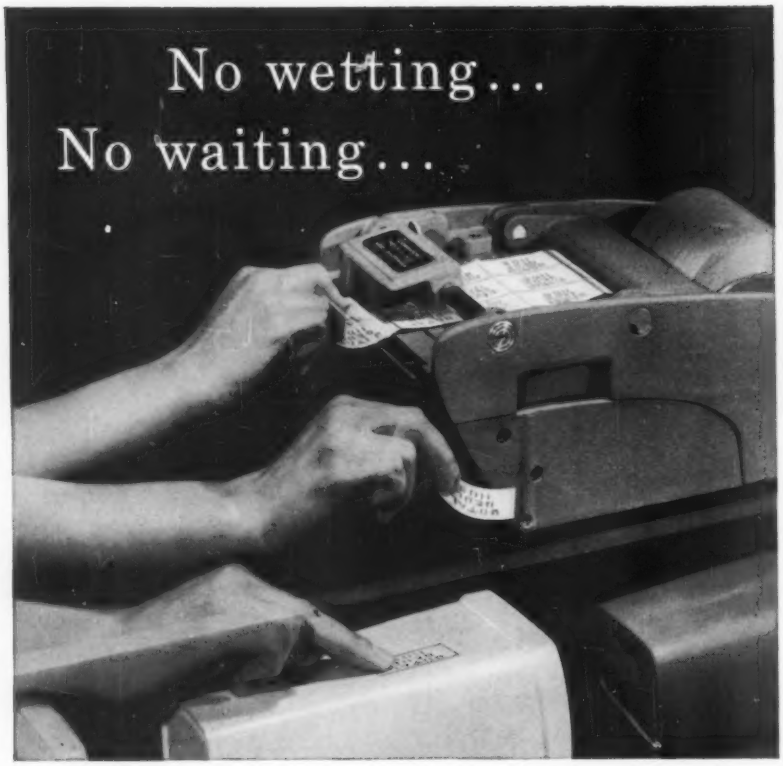

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√ Available in a wide range of shapes, sizes, colors — Dennison-designed to fill *your* requirements.

√ Available with permanent or removable adhesive.

√ Long shelf life.

Dennison offers four convenient PRES-a-ply Dispensers — manual or electric. They are easy to load and operate. They speed labeling, insure against label spoilage.

For more information write

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**Registered trademark for Dennison self-adhering labels and seals*

"Woven" Mylar

One more area of the consumer product world has now been successfully invaded by plastics: radio and TV speaker grille cloths. By an artful combination of embossing and perforation, a woven effect has been produced in metallized Mylar sheeting. The plastic material is less expensive than the cloth conventionally used for speaker grilles; it is stronger and more durable as well. The metallized sheeting, backed up with vinyl, was developed by Coating Products, Inc., Englewood, N.J., for a nationally known manufacturer of high-fidelity equipment.

In producing the Mylar "cloth", a metallic coating is vacuum deposited on ½-mil polyester film; then the film is laminated to 12-gage vinyl sheeting. The next step is embossing of the laminated material by a separate, automatic operation. Rolls of the sheeting are fed through male and female rollers, which emboss the sheeting with the aid of heat and pressure. The last operation is the perforation, accomplished by a male roller which punctures the material. A soft female roller holds the plastic in place, and receives the punches of the male roller.

The material is available in rolls 27 in. wide, or in sheets cut to specific size. Perforations run to 240/sq. in. Many patterns are available, and finishes include gold, silver, and copper.

Credit: Mylar film supplied by Du Pont.

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NB/160 - NB/200
NB/360/520

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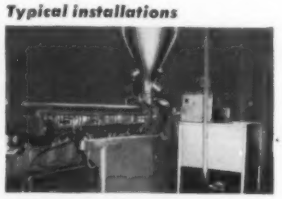

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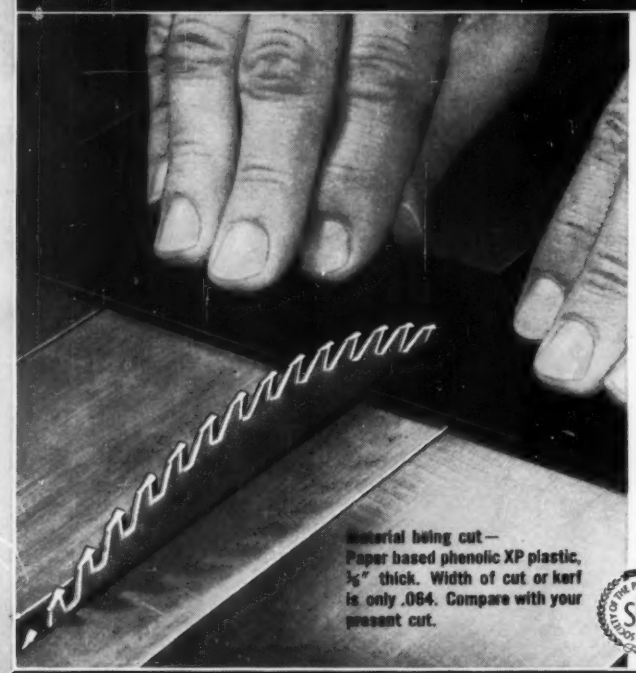

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(*From pp.* 103-108)

tection of metal parts during storage and shipment and foamed plastisol coatings which may be used when a relatively thick, "cushiony" type coating is desired.

Recently announced by the Chemical Processing Div. of Auburn Plastics, Inc., Auburn, N. Y., is a new strip-off plastisol coating for metal parts.

Foamed coatings: Sterilkote Plastisol Series No. 400, produced by Bradley & Vrooman Co., Chicago, Ill., is among the hot-dip-foam-type plastisols now available. It can be formulated to produce varying degrees of foam densities from a soft to a firm sponge. Among its characteristics are sound-deadening and shock-absorbing properties. One of the most interesting applications of this material is in a potato harvester made by The Dahlman Mfg. Co., Braham, Minn. This machine has conveyor bars, chain conveyors, wheel elevator, and clod eliminator coated with the sponge-type plastisol, which gives the potatoes a bruise-free ride and helps cushion shock at transfer points. Each machine incorporates approximately 200 lb. of the plastisol.

Drip rail sealers: Putty-like plastisol compounds based on Bakelite's vinyl are being used by some automobile manufacturers as drip rail sealers—the bead laid down at the joint between the roof panel and the drain trough around the roof edge of most automobiles. The plastisols serve as a waterproof seal to prevent water from entering the spot-welded joint and causing rust.

Coating appliances and wire goods

In the 1957 line of General Electric dishwashers, a pink plastisol spray-on coating is used on the interior of the tub, the cover, and the rack supports, and a coral-colored plastisol coating is used on the interior dishracks (see Figs. 6 and 7, p. 105).

Previous to the present line, the GE dishwashers used a porcelain enamel tub interior coating highly sensitive to chipping. The switch to vinyl plastisol for this purpose resulted in many advantages. Dents or bent flanges in the tub can now be straightened without damaging the plastisol coating. Also, any cuts made in the coating during manufacturing operations can be readily repaired.

Geneva Modern Kitchens, Div. of Acme Steel Co., Geneva, Ill., uses plastisol-coated wire shelves throughout its extensive line of kitchen cabinets. The coating is permanently flexible, will not chip or crack with age, and is not damaged by hot or cold food, beverages, and/or household chemicals. Record racks, furniture backs, farm baskets, and hardware cloth are typical of the many other wire products now being coated with vinyl plastisols. A cold dipping process, in which the metal object is immersed in the plastisol solution without preliminary preheating, may be used for coating wire

(*To page* 228)

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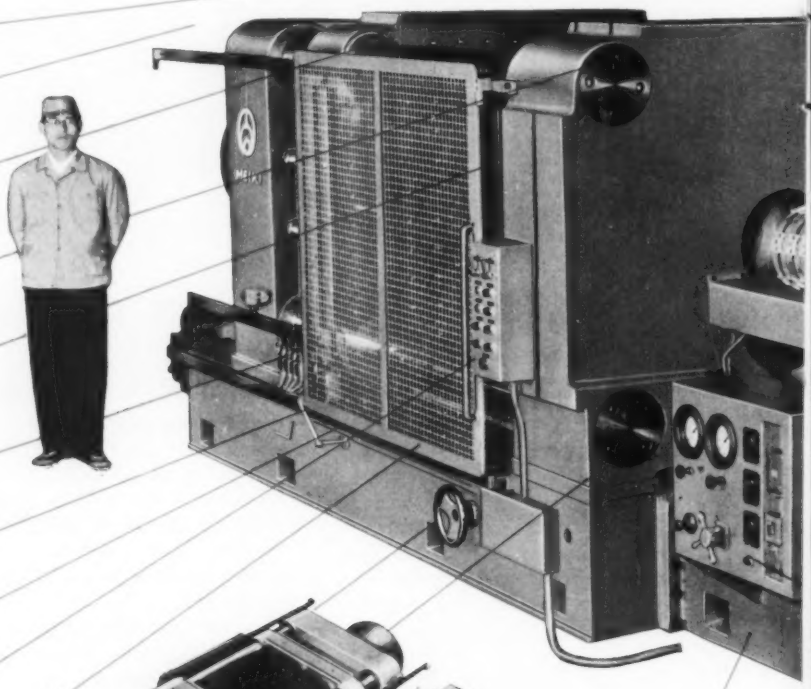

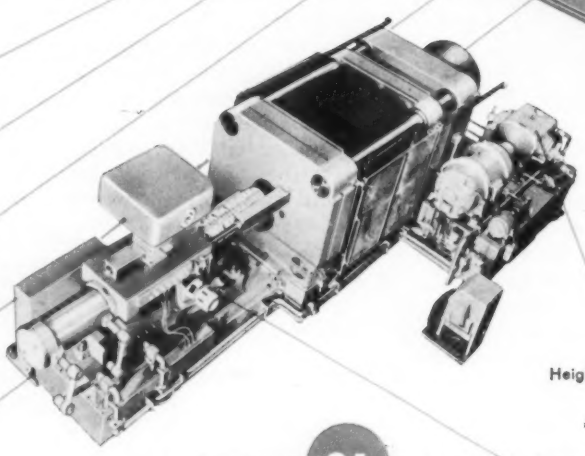

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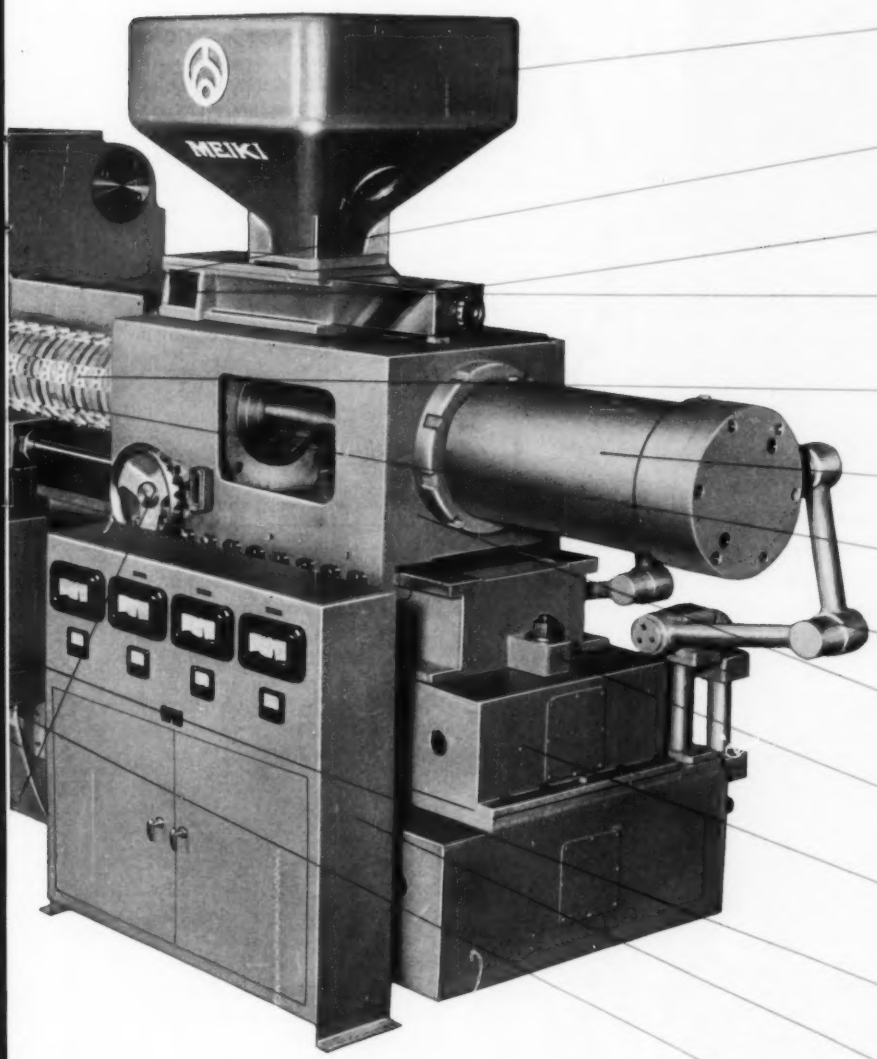

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goods. Curing is accomplished by conveying the parts through a suitable oven.

Coating metal sheet

A relatively new market for plastisols involves the coating of metal sheet stocks which are later fabricated into finished products. Sun Steel Co., Chicago, Ill., a pioneer in adapting plastisols to this process with its Texcote vinyl coated steel and aluminum, claims that this product is far superior to any other metal finish now available from the standpoint of beauty, color potential, and wear resistance. Economy is also an important factor.

Among the first applications of plastisol-coated metal to reach the market are an amplifier cover for a new line of portable record players introduced by Motorola, Inc., (see Fig. 8, p. 106), and a motion picture screen case produced by Radiant Mfg. Co. The amplifier cover is fabricated of aluminum coated with a white morocco-grained vinyl plastisol, while the screen case is of sheet steel, coated with a blue covering in a California morocco grain pattern.

Sun Steel Co. uses Bradley & Vrooman's Sterilkote No. 500 plastisol for its metal-coating operations. By embossing the material immediately after the baking operation, countless textures can be produced. Multi-colored effects are also easily obtained by spatter-spraying the plastisol with one or more colors just prior to fusing.

Radio and television cabinets, wall paneling, desk tops, wall tile, automotive dashboards, luggage, typewriter and business machine housings, jewelry, camera and projector cases, display shelving, and waste baskets are typical of the products which may be economically fabricated from plastisol-coated steel or aluminum.

When properly applied, the plastisol film cannot be separated from the metal surface without rupturing the film. The coating may have a hardness of 65 to 95 Durometer on the A scale, a tensile strength of 2000 to 3500 p.s.i., and a maximum elongation of 300 percent. The abrasion resistance of such a coating is from three to five times that of a high-quality refrigerator enamel.

Coating glass

Outside the metal field, the high tensile strength and good elongation properties of plastisols have led to their extensive use as protective and decorative coatings for various types of glass containers. Applied by the dipping process, a tough plastisol "skin" on glass aerosol containers prevents dangerous fragmentation in the event of accidental breakage. When required, the use of completely opaque or special coatings having an added ultra-violet absorber protects glass-packed products from harmful ultra-violet rays.

Cast films and coatings

Large quantities of vinyl plastisols are used each year in the production of cast films and as coatings for numerous types of fabrics. Plastisols may be applied

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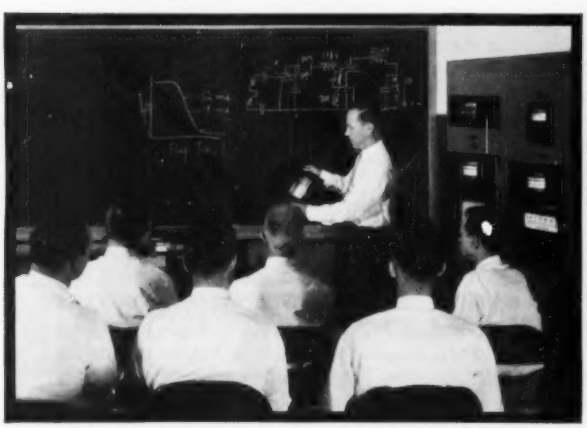

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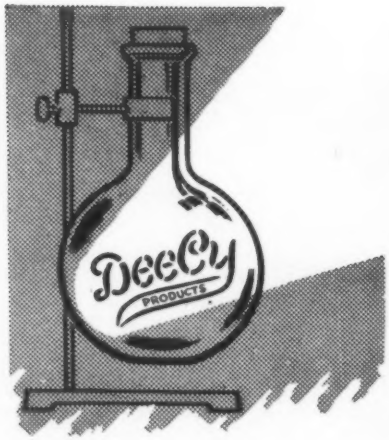

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to fabric or paper by means of conventional knife or roller-coating equipment, supplemented by an oven or radiant heating system to produce the required fusing temperatures. A practically limitless variety of designs and textures can be roller embossed into the coatings and the range of available colors is equally varied.

The uses of plastisol-coated fabrics cover a number of industrial and consumer products. Many of the coated fabrics find their way into the upholstery field. In addition, there are such specialized applications as coated fabrics for awnings and truck covers. Canvas shoe covers with plastisol-coated soles are used by workers at an Oak Ridge atomic energy plant to help prevent the spread of radioactive contamination. (See Fig. 9, p. 106.) Plastisol-coated nylon, is used as the liner in king-sized lightweight backyard swimming pools.

Somewhat related to cloth coating is the use of plastisols to coat glass yarn which is later woven into insect screen. The process used, described as wiping, consists of pulling the yarn through a bath of the plastisol at a rate of 500 to 600 ft./min., then passing it through dies of controlled diameter which regulate the distribution of the coating. The yarn then enters a heating unit where the coating is fused. A similar process is used in coating yarn for glass braided "spaghetti" tubing used in electrical components.

Many types of cloth industrial gloves, coated with a tough, chemically resistant plastisol covering, are also now on the market.

Dip molding

The fact that a properly formulated plastisol will form a closely conforming skin on molds dipped into it and withdrawn slowly, makes possible production of numerous simple parts by a dip molding process. After the plastisol has been fused, the flexible material is stripped off the mandrel and the mold is ready for another dipping operation. Tiny tips for ends of wire skirt hangers, slip-on covers for keys, and covers used to prevent gasoline station nozzles from scratching automobiles are typical of the products made by this method. (See Fig. 10, p. 107.) The same basic process is widely used in the production of plastisol overshoes. It is also possible in products of this type to combine layers of regular and foam plastisol to provide increased cushioning and insulation.

Slush and rotational molding

Slush molding and its mechanized counterpart, rotational molding, are other important production techniques for the vinyl plastisols. In slush molding or casting, a lightweight metal cavity is filled with liquid plastisol and the desired wall thickness is produced by gelling the material next to the mold with heat. Excess plastisol is then poured out and the remainder fused by subjecting the mold to curing temperatures. Finished items may then be stripped from the mold.

In rotational molding, the principle involved is similar, but provision is made to carry the mold or group of molds automatically through a controlled temperature oven. During the oven curing cycle, the closed mold is slowly rotated and oriented in two planes, causing the measured plastisol to flow into all interior areas of the mold, and building up a hollow object of the required thickness as it cures. At the end of the fusing cycle, the mold is cooled by a cold water spray and opened, permitting removal of the finished part. (See MODERN PLASTICS Encyclopedia Issue, p. 760.)

One of the earliest applications of slush molding was in the production of dolls. (See Fig. 11, p. 107.) Other toy items which proved to be a "natural" for flexible plastisols and the slush molding process include tub toys and hand puppets. These products can be decorated with vinyl-based finishes which will not flake off.

Rotational molding offers a method of producing one-piece, hollow products containing from a few ounces to several pounds of plastisol. Undercuts and complicated shapes present no problem, since no core is used in the mold.

Rigid plastisols

More rigid objects may be molded with rigid types of plastisols. Whereas previously a Shore

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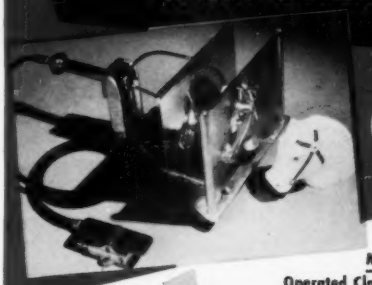

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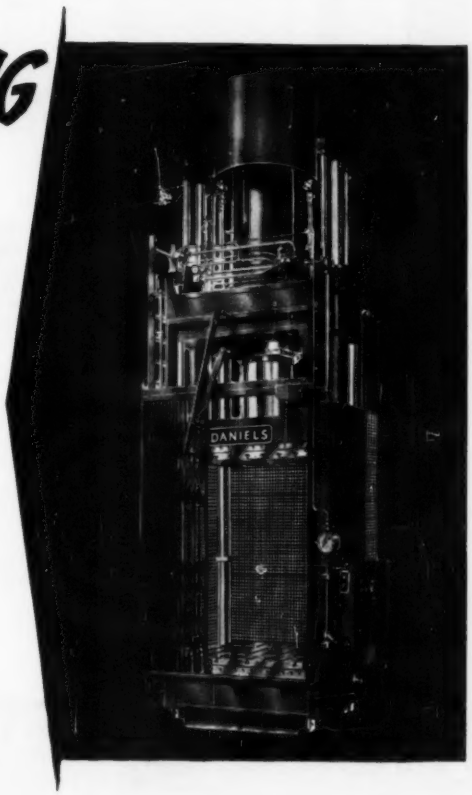

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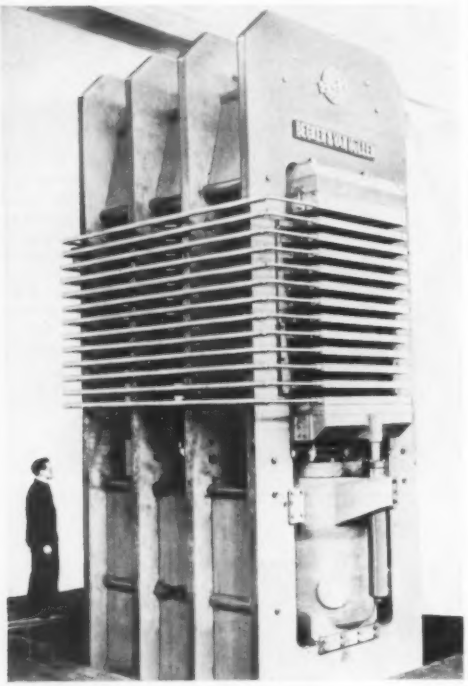

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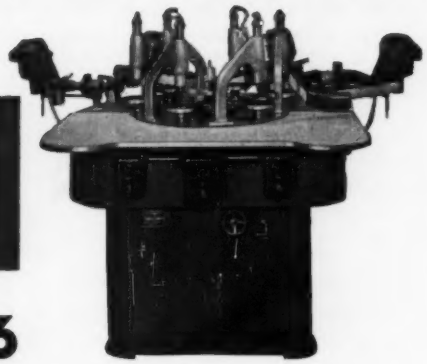

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A Durometer of around 100 marked the maximum hardness available in plastisol compounds, processors may now avail themselves of materials having a Durometer of 75 on the Shore D scale.

The emergence of the rigid plastisols opens the way to many new application opportunities. Life-like artificial fruits, mass-produced by rotational molding, are among the first consumer products, outside the novelty field, to reach the market. On the industrial side, an interesting rigid item is a battery service kit rotationally cast by Sun Rubber Co., Barberton, Ohio, from Geon resins supplied by B. F. Goodrich Chemical Co. (See Fig. 12, p. 107.)

In its 1957 line of cars, one of the major automotive manufacturers used a wide variety of one-piece defroster distributor ducts rotationally molded of rigid plastisol. The function of these ducts is to carry warmed air from heater housing to windshield outlets. Previously, these ducts, since their complicated shape involved several changes of cross-section thickness, had to be made in two parts of another material.

Several rigid plastisol hobby horses now being made by rotational molding emphasize the entry of this material into much larger parts. One such unit, being molded by Plastic Rotocast Co., Chicago, for Storkline Furniture Corp., contains approximately 6 lb. of plastisol supplied by Reslac Div., The Borden Co. (See Figs. 1 and 2, p. 103.)

Some rotational molders feel that the development of harder plastisols with higher heat resistance, more highly developed automatic equipment, and a satisfactory method of producing thin-gage metal molds would help broaden application possibilities. The way is wide open for important developments in this field.

Clay pipe joints

Another potentially large market outlet for plastisols is in the clay sewer pipe industry. Although for centuries the properties of vitrified clay have made it ideal for sewer pipe, the industry has searched many years for a better type of joint to be used between pipe sections. The joints must be tight and able to withstand the attack of acid and alkaline wastes, hot water, and sewer gases over a long period of time. They must also have sufficient flexibility to compensate for slight settling of the pipeline without leaking or cracking.

Natural dimensional variations in clay pipe make separate gaskets impractical, while the poured bituminous joints now in wide use lack the permanence of the pipe itself.

To meet these requirements, a number of clay pipe manufacturers have turned to specialized formulations of plastisols.

It is estimated that more than 2 million *tons* of clay pipe are produced each year. The weight of the plastisol joint often amounts to about 2% of the weight of the pipe. The potential volume of this market is thus readily apparent.

The cost of pipe sections with plastisol joints is still some-

what higher than that of pipe sections designed to be conventionally joined together. However, the economies realized in laying pipe with plastisol joints (often, it can be done twice as fast as with conventional techniques) more than offset initial cost.

Indicating the amount of plastisol involved in the application is the fact that as much as 11 lb. of plastisol can go into the two gaskets on each section of 24-in. pipe. When these pipe sections are installed in the field, mating sections are coated with a combination lubricant and solvent sealer which makes them easier to join and produces a leakproof bond between them.

Somewhat similar to the pipe joints are the plastisol end gaskets now being used on carburetor air cleaners by two major automotive manufacturers. These low-profile filters, which are completely dry and may be dusted or blown out for cleaning, incorporate a special corrugated paper as the filtering medium surrounded by a wire mesh enclosure for added strength. The flexible plastisol rings used on the top and bottom of the filters are made by placing them in ring-like molds, pouring liquid plastisol to the required depth and curing it. The operation is repeated for each end of the filter. The cured plastisol not only consolidates each end of the filter into a sealed assembly, but also provides an excellent air-tight gasket at the top and bottom when the filter is mounted in position.

Future developments

The above examples indicate why these versatile materials are winning an increasingly important position in the plastics field. Work on the plastisols for industrial applications (Figs. 13 and 14, p. 108) has only started and much remains to be done with rigid plastisols (Fig. 15, p. 108). In the opinion of one plastisol formulator, the increasing awareness of product possibilities by designers in various fields marks a major breakthrough in plastisol applications. He believes that the most interesting developments in plastisol applications today, and probably for the future, involve integrated applications wherein the vinyl dispersion serves a multi-functional purpose—the type of application for which the versatility of the vinyl plastisols seem ideally suited.

Credits: MODERN PLASTICS wishes to acknowledge the cooperation of the following resin suppliers, vinyl processors, and plastisol fabricators in supplying information and photographs in conjunction with this article:
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Automated sheet

(*From pp.* 122-125)

actuated by means of a specially designed photoelectric cell device which is mounted on the stacker frame.

In addition to automatic actuation, the shear is provided with a continuous cycling arrangement which cuts the sheet into short strips for easy granulation during set-up.

Since moving and closely spaced rolls inevitably present a hazard to operator's hands, provision has been made to reduce the danger to a minimum. Safety lines stretch across each roll nip on the polishing unit and the pull rolls which apply dynamic braking to both drives and open all roll nips automatically. It is thus almost impossible to sustain serious injury at any of these danger points.

Automatic stacking

The sheet is received by a stacker which consists of two horizontal banks of conveyor belts which travel at much higher speed than the sheet. As soon as the sheet is cut, it is conveyed to the far end of the stacker where it strikes a Microswitch. This actuates an air cylinder which swings the conveyor belts out of the way and drops all sheets at the end of the stacker. Provision is also made for manual stacking of extruded sheets. This is particularly useful with some of the small pieces that are used in custom sheet forming.

The sheet haul-off is driven by means of two individual remotely controlled variable speed drives. One 2-hp. motor powers the polishing rolls while a second drive powers the pull rolls. The drives are integrated to maintain constant differential over the entire speed range with a separate control for differential speed. This simplifies operation and reduces strains to a minimum. A 20:1 speed range is available for optimum production rates of all sheet thicknesses.

All controls of the sheet haul-off—speed and temperature controls as well as all contactors, fuses, etc.—are located in a control cabinet on the polishing stand. A hinged door provides easy access for maintenance and the cabinet is gasketed to prevent entry of dust. One single electrical plug-in provides all power for the entire line and self-sealing quick-disconnects for air and water permit rapid removal for machine cleaning. All services are brought in from the ceiling to avoid tripping hazards on the floor. Plug-in connectors distribute all of the services from the polishing stand to the various other units.

A dual-turret constant-tension winder can be inserted between the stacker and the shear to make rolls of thin sheeting. This winder is provided with Dynamatic constant-tension drives which maintain an adjustable tension on roll diameters up to 20 inches. Indexing of the turret is accomplished by means of a Gearmotor, a system which avoids waste between rolls. The turret winder is an independent unit which automati-

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cally adjusts to the sheet speed. The shear is naturally deactivated while the rolls of sheeting are being wound.

Beta ray gaging

Perhaps the most significant advance in the present installation is the incorporation of a continuous gaging device on the take-off unit. An Industrial Nucleonics beta ray "Accuray" gage scans the sheet as soon as it is cooled and records the thickness on a strip chart. It is thus possible for the operator to have a precise and continuous picture of the sheet gage at all times. The usual system of manual gaging used heretofore has a number of serious shortcomings which are particularly detrimental to short runs and which create considerable delay between machine start-up and production of "on gage" product.

First, there is a time delay, often of several minutes, between the time the sheet emerges from the die and the time it is cooled and ready for measuring at the end of the line. This means that the operator must wait this long between die adjustments. Since changes in one portion of a sheeting die necessarily affect all other sections, it often takes an hour or more before a die is properly adjusted under the manual measuring system.

Second, manual gaging of a wide sheet relies upon the operator's memory for thick and thin spots and their location. This often leads to adjustment in the wrong areas. Furthermore, single or even double transverse checks do not provide an accurate and true picture of the sheet contour. Since conditions tend to drift during the early part of a run, spot checks cannot be depended upon to reveal the exact condition of the sheet.

Third, when sheet is wound in rolls, a transverse thickness check is possible only when the sheet is cut.

The beta ray gage eliminates all these problems and gives the operator a complete and almost immediate contour map of the sheet at all times without leaving the die. The recording unit is located next to the die so that

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all changes caused by die adjustments are immediately evident. Set-up time is thus reduced to ten or fifteen minutes at most. The beta ray gage also offers greater precision than manual gaging; differences as small as 0.0001 in. are readily detected. The continuous record given by the chart provides a permanent quality control check which is preserved for future reference. It also permits an analysis of down-time, which provides management with a valuable tool for improving the efficiency of the over-all extrusion operation.

It has been found that the beta ray gage permits relatively unskilled operators to produce perfect sheet. This represents an important step forward since experienced operators are almost non-existent in this rapidly expanding field.

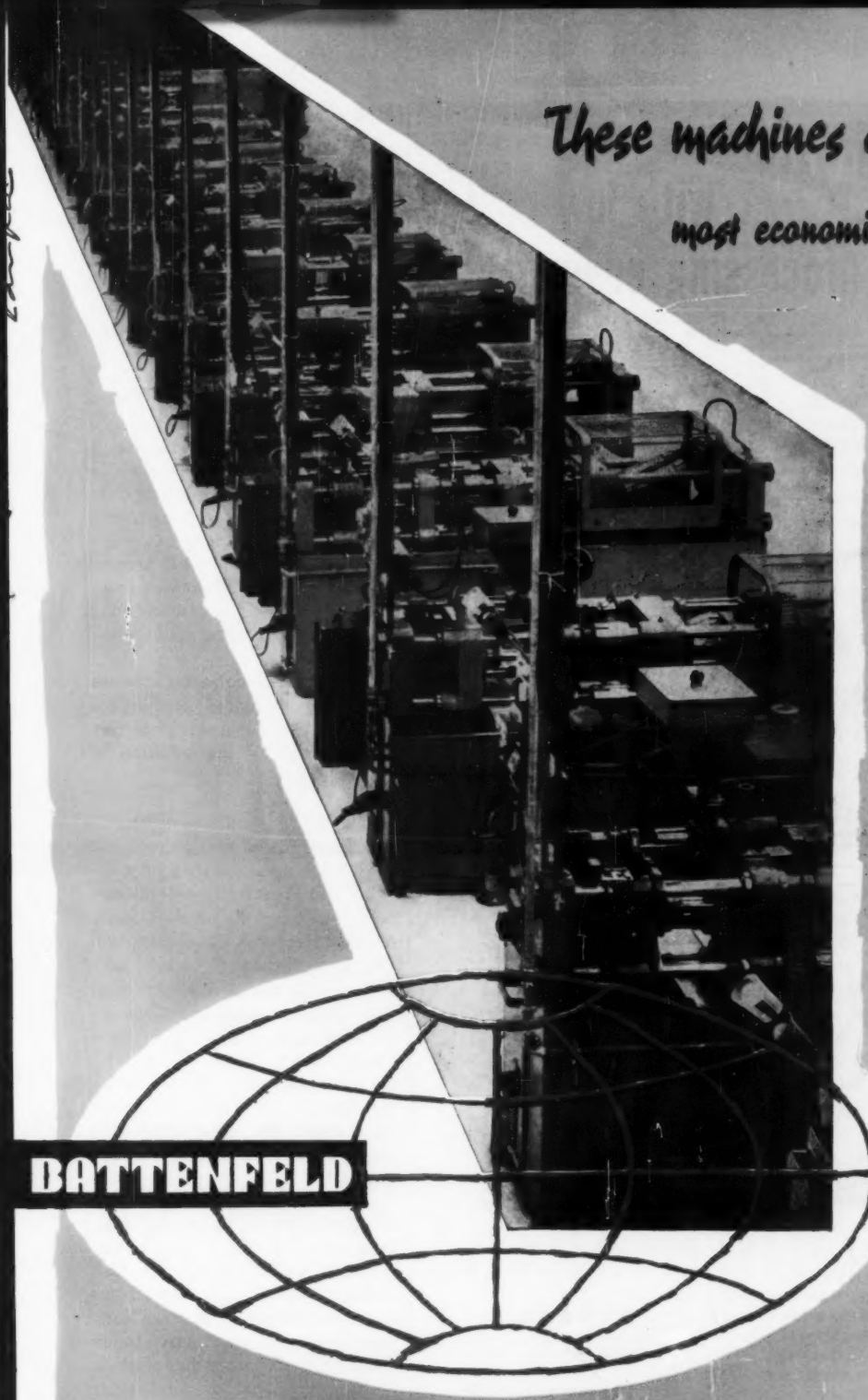
The beta ray gage not only offers savings in start-up time but, even more importantly, a continuous economy of material. Since tolerances are usually set up in such a way that a certain minimum thickness must be maintained, a sheet with closer control can be consistently run closer to this minimum. For example, let us take a sheet specification of 100 mils ± 2 mils. This means that no area of the sheet may be under 98 mils. If production tolerances are ± 2 mils, an average thickness of 100 mils must be maintained. If tolerances can be reduced to ± 1 mil (which is the case with a beta gage), an average thickness of 99 mils can meet specifications. It is easily calculated that this 1-mil savings can amount to about $10,000 per year on a single line. This saving, together with the savings of start-up and labor cost, pays for a gaging system in an amount of time which is very short indeed.

Future of sheet extrusion

Since sheet extrusion is the fastest growing phase of the extrusion field, it is to be expected that many additional refinements will be incorporated in the future. The rapid entry of most major appliance manufacturers into this field makes a completely automated plant essential, because sheet extrusion is only a minor phase of the over-all manufacturing operation.

One major improvement readily comes to mind: the closing of the loop between gaging and die adjustment by an automatic device. This has been the subject of considerable development work and a completely automatic control system is now under construction.

This is a relatively easy step with a beta ray gage and will undoubtedly result in a sheeting plant where the operator merely provides extruder feed and takes away the finished product. As in all complex plants, highly qualified maintenance personnel will become necessary for continuous and efficient production. Experience in other fields has shown this to be a small price to pay for the myriad advantages which accrue as a result of plant automation.—END



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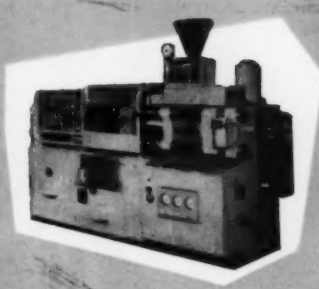

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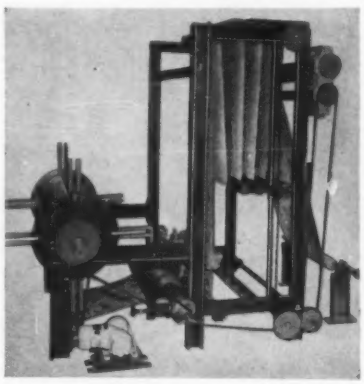

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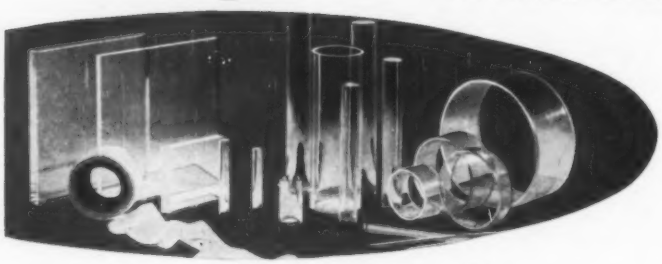

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Plastics lenses

(*From pp.* 118-121)

to have possibilities for lenses because of the properties imparted by such copolymerization.

Polyesters

By proper formulation, polyester resins can be cast at room temperature into moderately simple or compound lenses. Massive lenses with a minimum of flow marks can be cast. The material resists crazing and is impervious to many chemicals. Polyester lenses may also be exposed to considerable heat, such as in the condenser of a projector. Copolymerization of the liquid is accomplished by the addition of catalysts (usually organic acids) and heat. Castings can be made without pressure.

Unmodified polyester resins range from water-white to yellow in color. Transparent tints can be achieved by the addition of resin dyes.

Allyl esters

As a result of the writer's investigation of a number of plastics, and research on plastics lenses in both the Dade County Medical Research Foundation and the Opto-Medical Research Laboratories, it has been determined that the allyl esters have characteristics most adaptable to ophthalmic lens formation.

In the laboratory, the transparent lens is cast at low temperature from the clear, colorless, water-soluble monomer to which are added other chemicals and a catalyst. The resulting lenses are extremely hard and strong, relatively insoluble, inert, and colorless, and free from internal stria, strain, or haze. The material has a low coefficient of thermal conductivity, and its refractive index closely approximates that of glass.

One new type of allyl ester ophthalmic lens, called the Medilens, has the following properties:

1) High impact resistance and superior tensile strength; 2) greater resistance than glass to welding spatter and high velocity particles thrown off by grinding wheels; 3) dimensional stability, unaffected by relatively low or high levels of temperature—will

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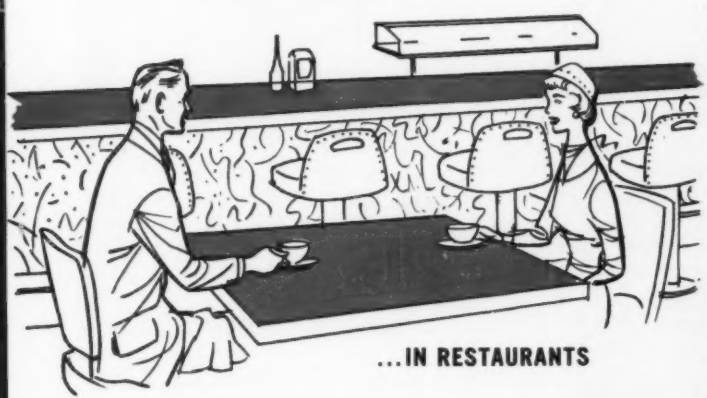

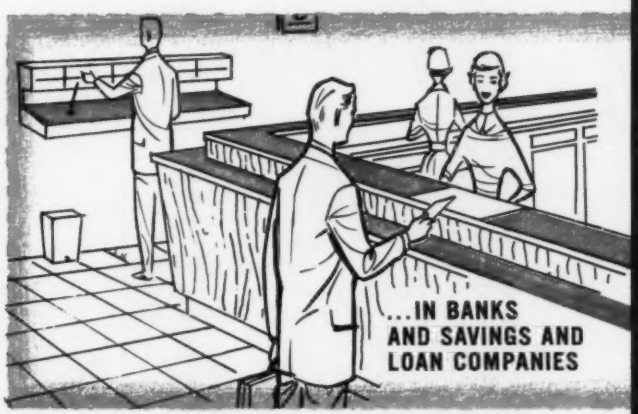

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not shrink, expand, or soften at high temperatures (300° F.); 4) a minimum of 40% less weight and 5% more transparency than glass; 5) fewer concentric rings of reflection; 6) imperviousness to ordinary household chemicals, including benzene, acetone, paint remover, and carbon tetrachloride; 7) greater abrasion and scratch resistance than other transparent plastics; 8) fogging of lenses is reduced by 60 to 75% as compared to glass; 9) clear water-white color is retained indefinitely; 10) greater ultra-violet light absorption; and 11) greater versatility than glass, from which lenses have to be individually ground. By proper mold design, corrected lenses can be produced that approach monocentricity; aspherical surfaces can also be produced and at a low cost.

Coloring lenses

Any color of the spectrum can be applied to plastics lenses. Intensities unavailable in glass can be produced. Any color arrangement, e.g., a clear central area and a tinted periphery, is feasible and complete uniformity of color is easily accomplished. If the tint of a complex lens is unsatisfactory, it can be changed by removal or alteration of the intensity of the tint. New tints can be custom prepared. High-vacuum evaporation, effective in imparting a uniform coating to glass lenses, can also be applied to plastics.

Methods of fabrication

Where the plastics lens is produced from finished sheet stock, only the optical, chemical, and physical properties need be considered. In one technique for using sheet stock, the heated thermoplastic sheet is formed into lens blanks by pressing between highly polished molds. Because these blanks are thermoplastic and not sufficiently resistant to abrasion or scratching, a thin coating, generally of a thermosetting material (although some thermoplastics have been used), is applied to the blank to increase surface hardness and alter external physical and chemical properties. All thin coatings, however, are only as hard as the substrate.

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radical Fresnal type lens has been developed by Eastman Kodak Co. It is made from a flat sheet of butyrate, pressed in a special brass mold. The mold is cut with circular grooves, 200 or more to the inch. The finished lens is still a flat sheet, yet it performs precisely as do regulation curved glass photographic lenses. The advantage of using such a lens is that it increases the over-all brightness of the image on the ground glass to a considerable degree. As yet, the lenses are unsuitable for ophthalmic purposes since the material is subject to abrasion. The potential advantages in lighter weight and in the increase in light transmission, however, would constitute tremendous advancement if application as a cataract lens were possible.

The most common techniques employed in lens fabrication (aside from the special methods described above) are:

1) Multiple cavity injection molding. High accuracy and low cost make this technique most desirable where the demand is for a quantity run in which optical and physical dimensions remain essentially static. Ophthalmic lenses, by contrast, which are based on varying eye prescription formulas, require individual handling.

2) Grinding and polishing sheet stock.

3) Lathe machining from sheet stock.

4) Low-pressure casting in either open or closed molds with some provision for shrinkage.

5) Spinning, as for concave paraboloids, especially applicable to reflective lenses for astronomical or other scientific purposes.

Conclusions

While the allyl esters seem to be the best lens medium available at present, offering so much more than glass, it must be borne in mind that application of this resin was undreamed of in the optical field just a few short years ago. Research in the young field of plastics will undoubtedly continue to yield other developments; plastics may offer possibilities for optics tomorrow that even the most informed observer cannot conceive of today—END

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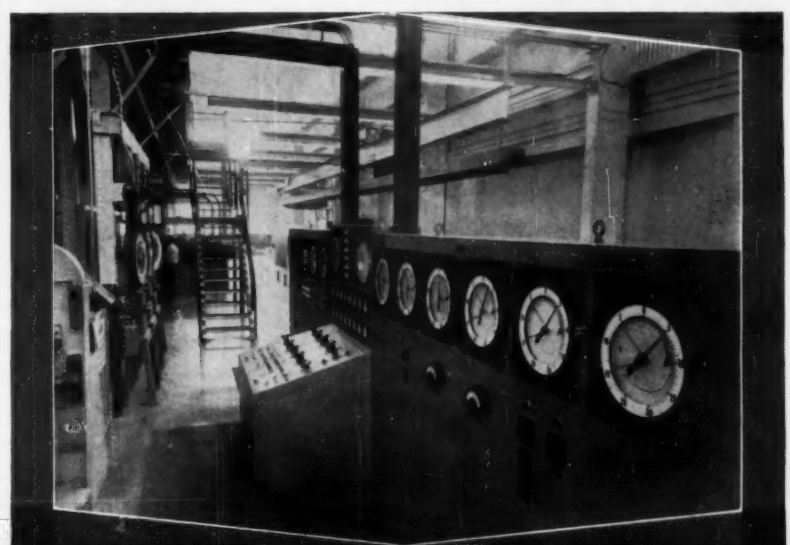

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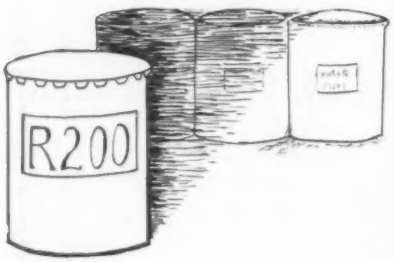

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A clear polystyrene refrigerator part was sprayed white on the second surface (backside). Also in production at that time was an acrylic emblem to be sprayed white, second surface. Scheduled for production was a styrene novelty that was to be decorated, first surface, with a white.

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Polyacetal resin

(*From pp.* 153-162)

molding temperatures, will cause scorching of the plastic. With the exercise of the usual care, acetal resin may be remolded repeatedly without suffering any significant change in properties or color.

The mold shrinkage of polyacetal depends on molding conditions and part geometry, but may be expected to amount to from 10 to 35 mils/inch. It releases cleanly from the mold. Internal and external threads have been readily molded, and parts stripped from core pins having no taper.

Extrusion of acetal resin is quite ordinary. Using conventional equipment and techniques, one can make rod, pipe, and shapes in a wide range of sizes. It blow molds nicely to give stiff, impermeable bottles.

Without exception, machinists who have worked with acetal resin have commented on its easy machineability. All the usual cutting, sawing, and grinding operations may be performed with even greater ease than on most thermoplastics because of polyacetal's combination of high softening point and high stiffness and toughness at high temperatures. It has also been threaded, blanked, and polished.

Joining polyacetal parts is something of a problem. Of course the common mechanical fasteners can be used where the requirements of the joint permit. But so far, no truly satisfactory adhesive has been found for the new resin. The best of the many materials tested give tensile shear strengths up to 500 p.s.i., a small fraction of the strength of the resin. However, polyacetal welds nicely by several standard methods and by friction- or "spin-" welding, in which the surfaces to be joined are rubbed together until sufficient heat has been developed to cause local fusion. The strengths of butt-welded joints are over 90% of that of the plastic. Because acetal resin has such a low power factor, it will probably be difficult to heat or weld it by the dielectric-loss technique.

The poor adhesion of the resin is probably associated with its solvent resistance. For the same

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reason it is difficult to print on polyacetal. Best printing results so far have been obtained through the use of the roll-leaf stamping process.

Since the material is naturally opaque white in color, it can be pigmented to any desired color and shade. A peculiar property that has been noted with polyacetal resin is that it imparts heightened sparkle and liveliness to the colors, possibly because of its high crystallinity.

Conclusion

To sum up, acetal resin looks very good as an engineering material. Its outstanding properties are its strength, toughness, and stiffness, even at high temperatures, its frictional and wearing qualities, its low creep rates under

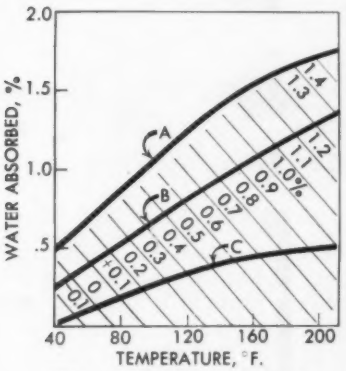

Fig. 11: Dimensional changes in polyacetal due to changes in temperature and equilibrium water content. Curve *A* is for samples immersed in water, *B* is for samples in 100% humid air, *C* is for samples in 50% humid air. Numbers on sloping lines indicate percent increase in length of specimen

substantial loads, and its resistance and impermeability to organic solvents and lubricants of all classes. It compares well to other plastics in fabricability and moldability. Its weaknesses are its vulnerability to UV and mineral acids, its reluctance to accept adhesives and inks, and its flammability. While it is at this date not yet a commercial product, polyacetal has price prospects that make wide usage of the resin in numerous applications a likely development.—*J.F.C.*

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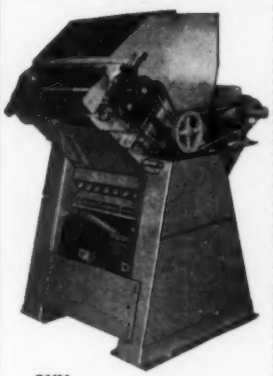

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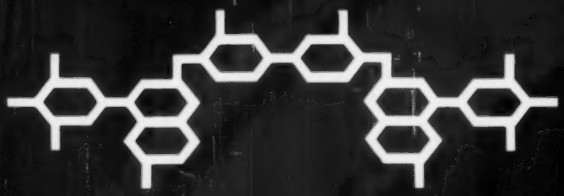

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Heat sealing

(*From pp.* 133-136)

coated glass coat—a different cloth would doubtlessly be equivalent to a different thickness of polyethylene film.

The observed differences in heat sealing performance of 1- and 2-mil films of Petrothene 200 resin are shown in Fig. 7, p. 136. Apparently there is little or no change in the operating *range* (on a percentage basis) as thickness changes; nor would such change be expected. However, it is clear that the *absolute* margin for error in timing shrinks sharply as the film becomes thinner.

Effects of gusseting

In sealing a gusseted, or pleated film, three interfaces rather than one must be sealed in a single step. Where the heat comes from one side only, it must penetrate three layers of film to bring the bottom interface to the molten state, without unduly softening the upper layers. This severely narrows the operating range, as the evidence of Fig. 8, p. 136, shows. Of course, the added thickness slows the process, too, in comparison with a simple seal of only two layers. Clearly it would be sensible to seal gusseted films with a sealer that supplies heat to both sides: not only would the process be faster, but the margin for error would be more generous.

The breadth of the satisfactory operating range in sealing gusseted film is very sensitive to pressure, as Fig. 9, p. 136, shows. The range at 40 p.s.i. is narrow enough, but at 240 p.s.i. it is almost non-existent. A fabricator attempting to seal this film at 240 p.s.i. and 450° F. would have to hit the required sealing time of 0.24 sec. within ±0.02 sec. in order to make a salable product!

Conclusion

The results of this study of heat sealing show that there is usually a comfortable operating region of time, temperature, and pressure that will produce good seals. The fabricator would do well to operate somewhere along the center line of the time/temperature belt, so as to avoid rejects due to uncontrolled fluctuations of conditions. Sealing gusseted films requires slower operation, particularly at high sealing pressures, not only because of the greater thickness, but because the narrow operating range forces the operator into a lower-temperature area where the sealing time can be reliably controlled. Further information from this study is available in a recent U.S.I. bulletin, "Heat seal characteristics of polyethylene films."

References

1. "Development of printability of polyethylene film by flame treatment," by J. A. Boxler, S. P. Foster, and E. E. Lewis; presented at 132nd national meeting of the American Chemical Society, Sept 10, 1957, New York City.

2. "Heat sealability of polyethylene film," by S. J. Jenkins, Jr., and S. P. Foster; this followed Ref. 1, above, at the meeting.

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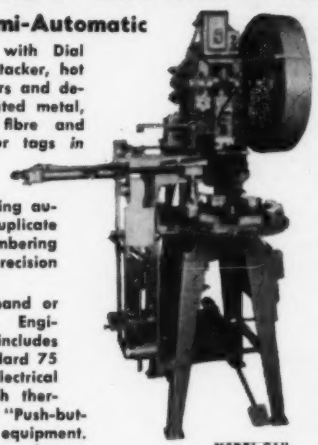

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Factors affecting

(*From pp.* 164-172)

which is shown, and to P. D. Ward, who did most of the compounding work and viscosity measurements. We are grateful to Dr. A. J. Urbanic, Assistant Director of Research, for his interest in this work, and to The General Tire & Rubber Co. for permission for publication of this paper.

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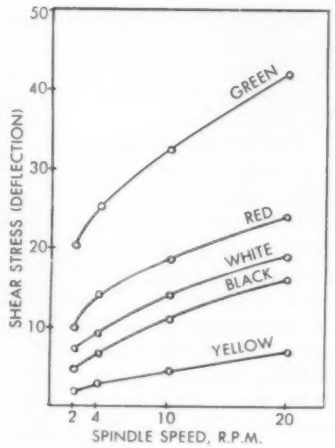

Fig. 9: Brookfield consistency curves of pigmented plastisols. Each plastisol contains 5 volumes of pigment per 100 parts by weight of PVC and 50 parts by weight of plasticizer

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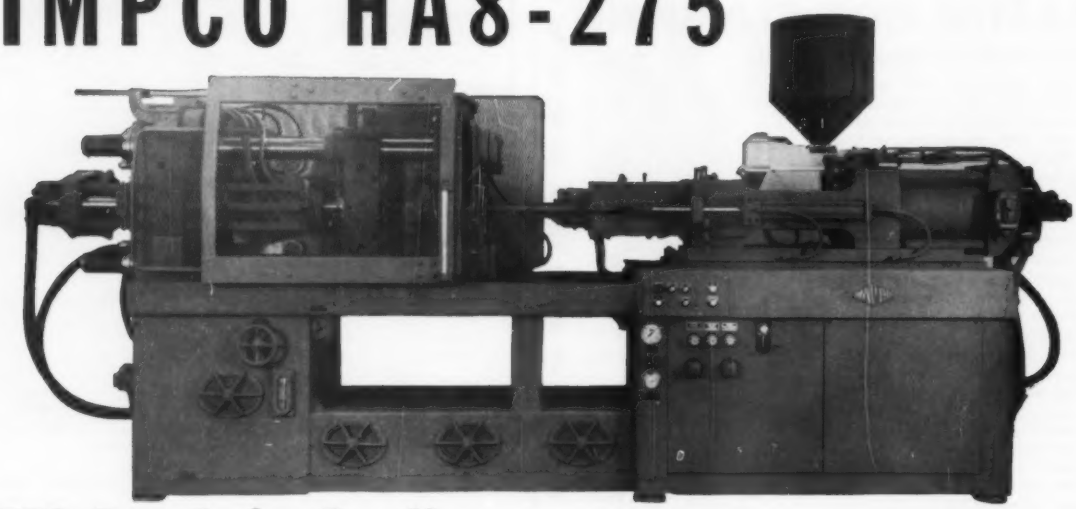

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Acrylonitrile

(*From pp.* 173-178)

it caused scorching or, possibly, cross-linking.

Details of the conditions are listed in Table II, p. 176. The copolymer was milled at the stated mill temperature using wool grease as the lubricant. The mill sheet was chopped to a fine mesh in an Alsteele Granulator and used in this form.

Aging of specimens

Specimens for aging were prepared from wire, over which the material to be tested had been extruded. Twelve 6-in. specimens of each material were aged at oven temperatures of 100, 125, 135, and 150° C. The wire sample was tested for flexibility at 25° C. by winding it three or four times around a ⅛-in. mandrel. The criterion of failure was the first visible sign of cracking in any one of the 12 specimens.

Results

The wide range of properties, both mechanical and electrical, as shown in Table III, p. 176, offers a stepping stone to selection and development of a copolymer with a particular set of properties. These properties, to a large extent, but not completely, were predicted by Mead and Fuoss (5) using ethyl acrylate and acrylonitrile. They showed that when both monomers are polar, the resulting copolymers may be expected to have properties intermediate between those of the two homopolymers because the orientations of both types of polar groups are subject to the restraint imposed by the chain structure. Polyacrylonitrile is hard and brittle at room temperature and has its 60-cycle loss maximum at 110° C. Polyethyl acrylate is very soft and flexible at room temperature, and its 60-cycle maximum is not very far from room temperature. Consequently, one could expect a decrease in dielectric constant and a shift to lower temperatures of maximum absorption loss, at a given frequency, for acrylonitrile copolymerized with increasing amounts of ethyl acrylate. Increasing the nitrile content caused the loss factor

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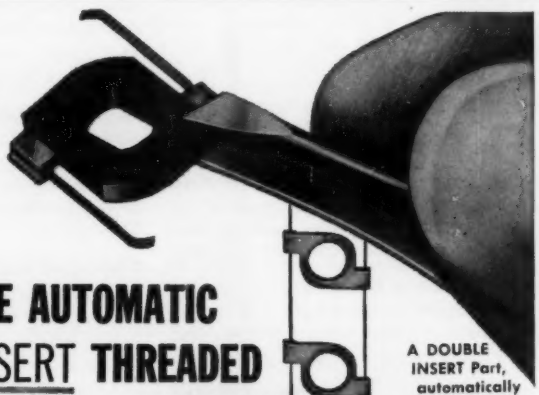

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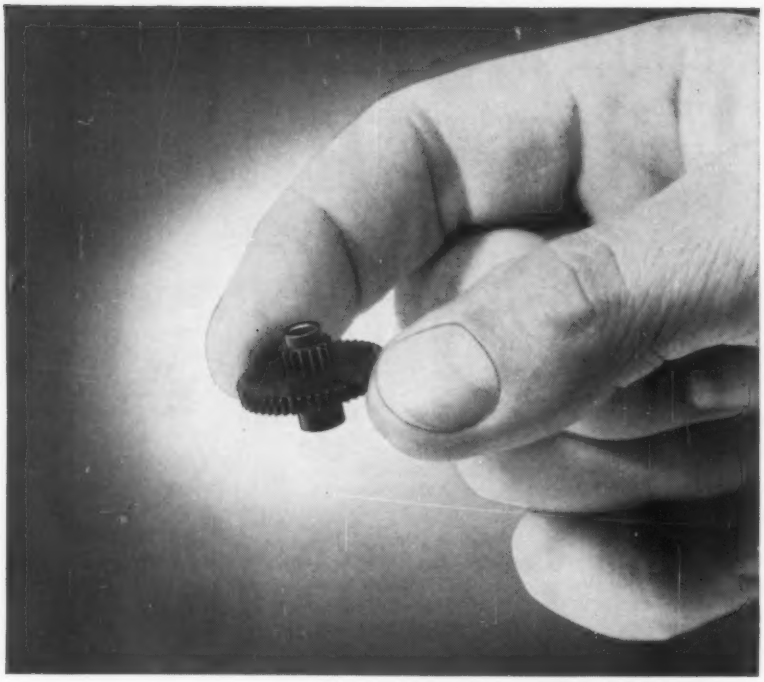

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maximum and the dielectric constant to rise corresponding to the higher dipole strength of the nitrile group as compared to that of the ester group. The peak absorption and maximum dispersion shifted to higher temperatures, indicating that the average relaxation rate constant decreased as nitrile content increased, or the "internal viscosity" increased.

Thus, with more nitrile groups on the chain, the probability of rotation is less due to dipole interaction between chains. This shift of electrical properties with composition is paralleled by the change in mechanical properties: the copolymers become harder and less flexible at a given temperature as the nitrile content increases. On the basis of d.c. resistivity the copolymers listed would be adequate as insulators. However, on the basis of power factor, it may be seen that many of the materials listed show increasingly high loss at the elevated temperatures. This is accompanied by poor mechanical strength at the higher temperatures. If one were to use power factor at 100° C. together with the information under the column headed "Mechanical properties," some useful materials could be selected. An outstanding one is that labeled 50A, the 50% (by weight) copolymer of acrylonitrile with decyl acrylate. This material could be milled and molded or extruded quite readily. It had good strength at elevated temperatures and showed resistance to moisture as measured by resistivity or impedance. Figure 1, p. 178, compares the effect of humidity on nylon and acrylonitrile copolymers while Table IV, above,

Table IV: Moisture resistance of acrylonitrile-*n*-decyl acrylate copolymer

Days in water at room temp.	0	1	7
D.-C. resistivity, ohm-cm.			
50A copolymer	7.6×10^{14}	4.8×10^{14}	2.5×10^{14}
Nylon-6/6	4.4×10^{13}	3.1×10^{10}	3.1×10^{10}

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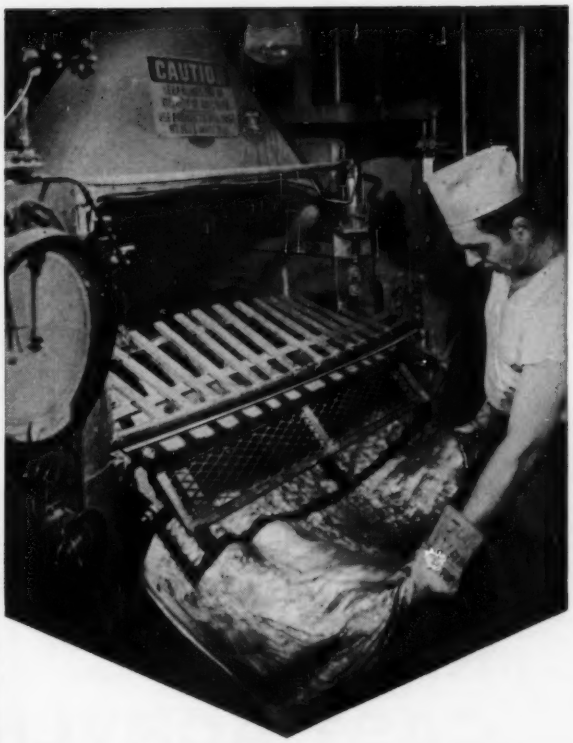

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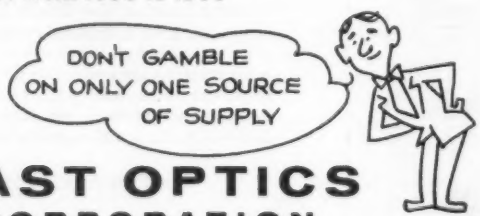

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shows the effect of immersion in water.

Other compositions are also of interest. Up through the decyl acrylate copolymers, a range of properties varying from rubbery, to hard and flexible, to brittle, could be obtained. However, above decyl, materials with little strength result, and these were labeled "cheesy." It would appear that, after the 10-carbon chain, packing similar to that in paraffins or waxes resulted as the properties of the alkyl group became dominant. The contribution of the nitrile dipoles became proportionately small at this point and the net effect was that of being buried in a hydrocarbon matrix. This also manifested itself in the relatively small power factor increase with temperature increase.

Table V: Aging time of copolymer wire

Sample No.	*Time to cracking at temperature*[a]	
	125°C.	*150°C.*
	hr.	*hr*
50A (50% decyl acrylate)	5449[b]	504
43I (59% butyl acrylate)	1824[b]	800
48A (55% 2-ethyl-hexyl acrylate)	—	454
Nylon-6/6	260	48

[a]Wire wound around a ⅛-in.-diameter mandrel.
[b]Aging still in progress at that time.

Table V, above, gives an indication of the resistance to embrittlement of some of these materials at elevated temperatures as outlined above. Nylon-6/6 is listed by way of comparison.

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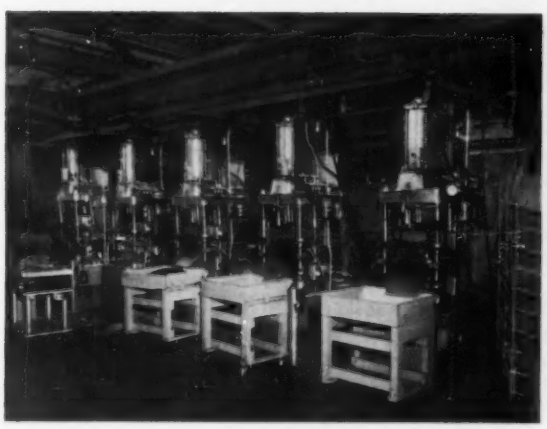

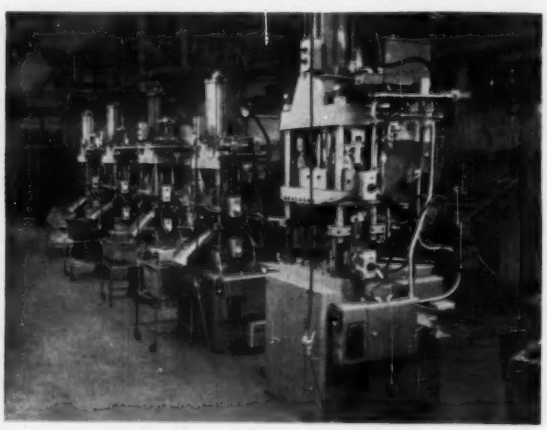

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The Plastiscope

News and interpretations of the news
By R. L. Van Boskirk

Section 2 (*Section 1 starts on p. 43*)

Benzoguanamine for plastics

Commercial production of benzoguanamine, an organic chemical adaptable for a wide variety of uses in the plastics industry, has been announced by Tennessee Products & Chemical Corp., 326 Union St., Nashville, Tenn. At the same time the company also announced that it is now producing benzonitrile in commercial quantities.

Benzonitrile is a basic chemical used in the production of benzoguanamine and also is widely adaptable for a variety of process industries, including plastics, organic synthesis, rubber, pharmaceuticals, and synthetic coatings. A colorless liquid with an almond-like odor, it is immiscible with water and is particularly useful as a solvent.

Benzoguanamine, a member of the triazine family of chemicals, is similar in many respects to melamine. Commercial availability of the basic chemical will now permit the formulation of compounds specifically tailored to meet certain requirements. Produced in the form of free-flowing white crystals, benzoguanamine has a mild organic odor and is relatively non-toxic.

Resins containing benzoguanamine are particularly serviceable in the manufacture of industrial finishes, plastics, paper products, adhesives, textile finishes, and molding compounds. It reacts with formaldehyde and alcohol to form triazine resin and can be processed with the same equipment and techniques as used for melamine.

Tennessee Products is a division of the Chemical, Paint and Metallurgical Dept. of Merritt-Chapman & Scott Corp.

Vinyl texture finishes

The eye appeal of textured finishes is combined with the durability of vinyl plastisols in M & T Armorhide organosols offered by Metal & Thermit Corp., Rahway, N. J. Developed by John L. Armitage & Co. and now manufactured and sold by M & T under license, Armorhide provides a spray-applied finish resembling grain leather. The pattern of the finish is said to hide imperfections in the metal surface to which it is applied, thus eliminating special surface preparation.

The finishes are said to have rubber-like flexibility and resiliency. According to the company, Armorhide is easy to apply, has good wear and chemical resistance, and has been found to outwear baked enamel finishes by as much as 10 to 1 in laboratory tests with Taber Abrasers and in actual field use. In addition, the vinyl-base organosol coatings are said to offer good resistance to moisture, acids, alkalies, perspiration, and other corrosives.

Applications include office equipment, business machines, communication equipment, etc. The finishes are available in a variety of colors.

Four varieties for Phillips

Marlex 50 rigid polyethylene resin is now available in four melt indices from Phillips Chemical Co., a subsidiary of Phillips Petroleum Co., Bartlesville, Okla. All four types of the improved material are said to retain the original Marlex 50 qualities of heat resistance, rigidity, and purity. The improvement makes possible a sharp reduction in processing time and enables the manufacture of large molded items.

The four types range from a melt index (MI) of 0.9 to 5.0. The higher the MI, the easier the flow of resin to the extremities of the mold without cooling.

Marlex 50 resin designations available are as follows: Type 9 (the original product), Type 15, Type 35, and Type 50. Each type number is arrived at by multiplying its melt index by 10. Type 50, for example, has the high MI of 5.0 and is particularly adapted to molding larger items such as garbage pails and refrigerator parts.

The other types all have broad applications, according to the findings of Phillips research. Type 9, toughest of the four, is claimed to be ideal for bottle blowing and for textile end products. Types 15 and 35, in the intermediate range, are suited to diverse applications ranging from toys and kitchen utensils to safety helmets and other items.

PVC clothing deal

A complete line of PVC-impregnated protective clothing, aprons, and vinyl-coated gloves will be made and marketed in the U.S. by a newly formed company, Jomac-North, Inc. The firm is the result of an arrangement whereby Jomac, Inc., Philadelphia, Pa., work-glove manufacturer, and James North & Sons, Ltd., London, Eng., PVC clothing firm, will market each others' products in both countries. The new company in England is North-Jomac, Ltd., London.

The product line which the arrangement brings to the U.S. includes both foul-weather and chemical-resistant clothing. The garments have a fabric base coated on both sides with PVC, and seams that are both stitched and electronically welded. The buttons are welded to the clothing so firmly that the garment will tear before the buttons come off. The foul-weather line, built up by James North & Sons to replace the traditional British oil-

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these four applications are improved with

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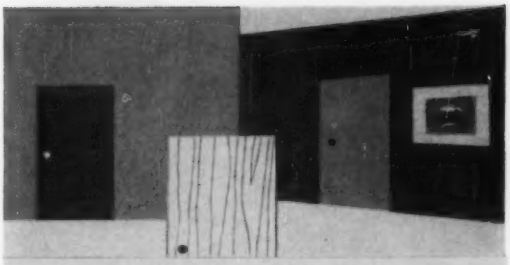

DECORATIVE LAMINATES made with DAPON resin do not require the usual "facing" steps. The printed paper can be laminated directly to the backing material in a single operation. For applications requiring soft backing materials excellent flows can be effected at pressures as low as 50 psi. With either high or low pressures, laminates of DAPON resin exhibit exceptional resistance to abrasion, chemicals and heat.

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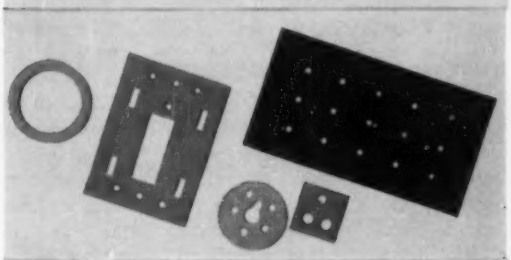

INDUSTRIAL LAMINATES made with DAPON resin have a number of outstanding properties: Superior electrical properties e.g., high insulation resistance retained under conditions of high humidity; heat resistance without degradation even under sustained vibrational stress. Other advantages exist in end uses requiring a high degree of chemical and moisture resistance, good dimensional stability, mechanical strength and ease of machinability. Formulated with or without volatile solvents DAPON resin is suitable for use in the full range of pressure curing conditions.

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The Plastiscope

skin, consists of jackets, coats, pants, and leggings; the chemical-resistant clothing includes, in addition, coveralls, aprons (bib and waist types), sleeves, and headgear.

The two principals in the arrangement are H. Howard Colehower, president of Jomac, Inc., now also named president of Jomac-North Inc.; and Geoffrey K. White, managing director of James North & Sons, Ltd., now also managing director of North-Jomac, Ltd.

Kraft paper for coating bases

Improved grades of X-Crepe, a cross-creped kraft paper-based material produced by Cincinnati Industries, Inc., Lockland (Cincinnati), Ohio, are claimed to provide better coating bases for plastic film lamination, simulated leather, and flocking.

The new types, said to be nonabsorbent and to have a smooth finish, are available in six different calipers, ranging from 0.010 to 0.040, in widths up to 54 inches. According to the company, there is no aging problem.

Almost any type of coating (from animal glue to vinyl) can be applied to the surfaces, resulting in a strong, flexible material. Since X-Crepe stretches in all directions, it can be formed into compound shapes or can be deeply embossed, using conventional processes, thus permitting the material to be used for decorative or industrial shapes of various sizes.

Spray for signs

An aerosol stencil spray for sign and window painting, based on a copolymer of vinyl acetate and vinyl pyrrolidone, has been developed by Du Pont chemists. It can be produced in a wide range of colors with a clear, uniform film that dries tack-free in minutes. The company asserts that on metal, glass, and similar nonabsorbent surfaces, the coating does not soften or run under ordinary conditions to which nonpermanent sign paints are exposed, yet can be removed quickly by wiping with a damp cloth or rinsing in cold water. On paper, wood, and other absorbent sign-painting materials, the film is absorbed evenly and the color cannot be removed easily by washing.

The facility with which the coating can be removed from metal and glass makes it usable in many places where other less easily removed decorative coatings, such as paints and inks, cannot be used for fear of soiling.

Du Pont's Freon Products Div., which developed the decorating spray, does not plan to market the material in aerosol packages itself but has offered the formulation to aerosol loaders and marketers.

Isocinchomeronic acid

Commercial quantities of isocinchomeronic acid are now available from Ansul Chemical Co., Marinette, Wis. The chemical is suggested as an intermediate in the preparation of polymers, dyestuffs, insecticides, and pharmaceuticals. According to the manufacturer, its ring—nitrogen—offers possible increased dye receptivity in polymer applications.

Material for molds

Fura-Tone NC 1002, a liquid molding material for the casting of vacuum forming molds has been announced by Minnesota Mining & Mfg. Co., St. Paul, Minn. Molds made from the new material are said to reproduce finer details than molds made from any other material now being used.

The preferred method of casting is with a preformed vinyl sheet as the pattern. This sheet can be formed over the original plaster or wooden mold and backed up with plaster or with the original pattern to support the weight of the mix during casting and curing. According to the company, for the majority of patterns where a vinyl sheet is used, no mold release is required.

Vitex Plastics Co., 830 Broadway, New York, N. Y., has been named distributor of Fura-Tone in New York, New Jersey, Rhode Island, Connecticut, and Massachusetts.

Dry wipe

A new high-speed dry wipe and letter fill material has been announced by Logo, Inc., Div. of Bee Chemical Co., Chicago, Ill. The material, designated X-134 series, is said to be exceptionally fast in dry time and sets to maximum hardness in two days. It can be used on most plastics, either on first or second surfaces.

Primers for fusing vinyl plastisols

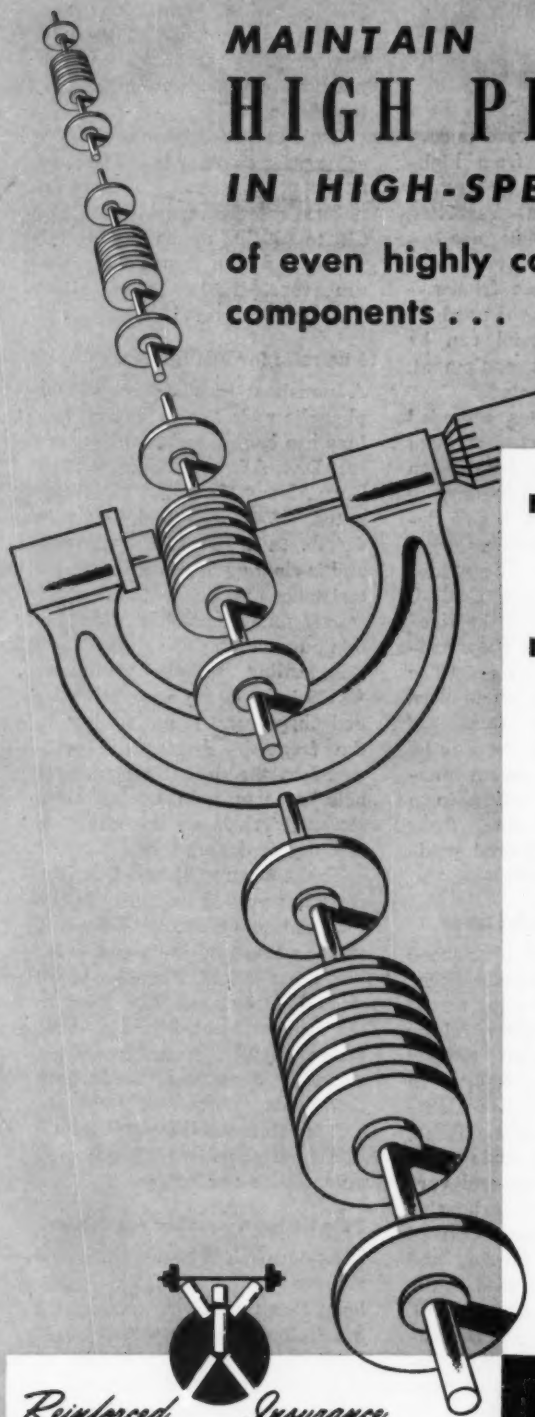
Two primers for fusing vinyl plastisols to metallic and nonmetallic surfaces have been developed by Dennis Chemical Co., 2701 Papin St., St. Louis 3, Mo.

Denflex No. 2394-1 White Primer bonds plastisols to metal to form coatings which are said to withstand immersion in cold or boiling water and exposures to conditions of high humidity. It is supplied at a viscosity suitable for roll coat application but can be thinned for brushing, flow-coating, or spraying. It requires a minimum of preheat before application of the plastisol, and even after baking is light in color.

Denflex No. 2394-30 Yellow Primer is claimed to have superior bonding quality and to provide extreme resistance to salt spray and salt water immersion.

Phenolic license agreement

A five-year license agreement, providing for the exchange of know-how and technical information, was recently signed by Catalin Corp. of America, New York, N. Y., and Cie Centrale Rousselot, 50 Rue Boileau, Paris, France. Catalin will disclose its formulas and technical information pertaining to the manufacture of solid one- and two-stage phenolic resins for adhesives, bonding, molding, and foundry uses, and permit Rousselot to manufacture in Sweden, Switzer-



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land, and in European countries which are now signatories of NATO.

The agreement provides payment for Catalin on a royalty basis and supplying of information on any processes the French company develops in the areas covered.

Prices down for fatty alcohols

Du Pont has announced a uniform 2¢/lb. reduction in price of Lorol fatty alcohols, widely used in the manufacture of plasticizers, oil additives, detergents, and in organic synthesis. The price cut follows recent congressional action in repealing, until June 1960, the processing tax on coconut oil, basic ingredient in Lorol.

Trowelable adhesive for foams

Bondmaster G458, a high-strength, quick-grab, fast drying, trowelable mastic for bonding Styrofoam, Dylite, and similar rigid and semi-rigid plastic (styrene, urethane, etc.) foams to themselves and to other materials, such as wood, metals, etc., has been developed by Rubber & Asbestos Corp., Belleville, N. J. The product, available in black or in neutral cream color, contains a special solvent blend, formulated to minimize or eliminate cell collapse due to attack on the surface of the foamed styrene.

The adhesive resists humidity and freezing temperatures, and reportedly does not give or transmit objectionable odor or taste properties to foods stored in refrigerators using the new bonding agent.

TAPPI Conference

High-density polyethylene looks like a wonderful material for paper coating. This was the substance of a paper presented at the 12th annual plastics-paper conference of the Technical Association of the Pulp and Paper Industry. According to the paper, by A. E. Irvine and H. A. Arbit, Bakelite Co., the extrusion coating field can look forward to several major benefits from high-density polyethylene: greater selection of functional properties, higher resistance to permeation, more protection per unit of thickness, and less surface friction—which may eliminate the need for additives. The material can be handled on present equipment, the paper also indicated.

Some 347 delegates attended the meeting, held Oct. 7 through Oct. 9 at the Sheraton-Gibson in Cincinnati. After two days of technical papers, Oct. 9 was devoted to a tour of Formica Corp.'s new Evendale plant. The official luncheon speaker was Carl J. Reith, vice president of the Kroger Co., who gave a showmanship-packed talk on "The Impact of Packaging on Modern Merchandising." An example of Mr. Reith's style was the way he called attention to a recent innovation of goldfish sealed in a polyethylene bag—he flung handfuls of the packaged goldfish into the audience!

Pearl essence manufacturer

Formation has been announced of Ultra Ray Pearl Essence Corp., Hyannis, Mass., under the direction of Ernest J. Petow, whose father first originated natural pearl essence in this country in 1918. The company's new decorative and protective finish, called Ko Pearl, is claimed to have all the brilliance and versatility of the more expensive natural pearl essence derived from the scales of herring and related fish. It is produced in the form of lustrous, transparent, hexagonal-shaped crystals, microscopic in size and high in reflectivity. According to the manufacturer, the pearl finish is colorfast, heat resistant, and non-corrosive; it is unaffected by most solvents and remains stable when exposed to sunlight and ultra-violet rays.

The new pearl essence is available for dipping, spraying, calendering, and other blending operations for application in plastics, paints, resins, inks, and lacquers. It can also be used on any properly prepared base of plastics, glass, wood, leather, metal, etc.

Ko Pearl sells at about the same price as other low-cost synthetic pearl essences. Prices for natural essence range from about $15 to $30/lb., depending on the grade and use. Synthetic prices are considerably lower—about $1.50 to $5 a pound.

Phenolic for can linings

A non-heat-reactive, oil-soluble phenolic resin for use in can linings has been developed by Barrett Div., Allied Chemical & Dye Corp., New York, N. Y. Designated #3725, the resin sells at 41¢/lb. in truck load quantities and is claimed to possess superior resistance to acids than other conventional materials used for this purpose.

According to the company, #3725 is based on a novel modified phenol and is not subject to the frequent shortages experienced in the production of phenols based on by-products. Long storage periods do not affect its stability or drying time.

The company states that the resin has proved its utility in the formulation of caustic tank linings and as an impregnant for bottle cap liners. Phenolic-based varnish linings are also used in the cans for meat, fish, and vegetables, as well as for cosmetics, cleaners, dentrifices, medicinals, detergents, and paints.

It is estimated that some 2 million lb. of phenolic resin are used annually as can linings.

Plastic lubricant for machines

Long-term lubrication can be achieved by Gulf Plastic Petroleum B, a thixotropic product for use in business machines developed by the Research Center of Gulf Oil Corp. The material is said to possess the qualities of a true plastic and will lubricate in a range of temperatures from below freezing to 150° F.

The company states that years of testing by National Cash Register Co., which has extensively evaluated the material, indicate

U.S.I.

Vol. II, No. 6

POLYETHYLENE PROCESSING TIPS

RESIN PROPERTIES THAT AFFECT STRESS-CRACK RESISTANCE OF POLYETHYLENE

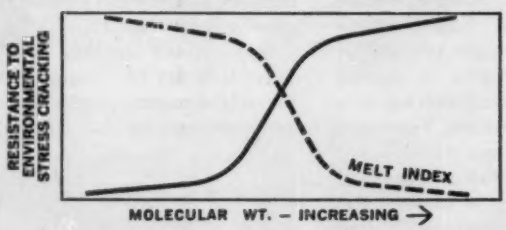
Environmental stress cracking is the term used to describe a certain type of material failure. With polyethylene this failure occurs when the plastic is under high local stress (either external or internal) and in contact with materials such as a soap, detergent, or solvent, which affects the polymer.

Resistance to stress cracking is especially important for applications such as electrical insulation, polyethylene pipe, housewares, and certain types of packages.

Two factors influence the resistance of a polyethylene part to environmental stress cracking: the resin used and the conditions used in fabricating the part.

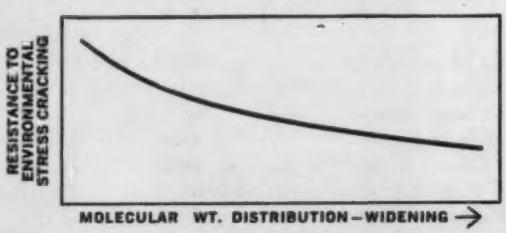
Which resin to use:

Stress crack resistance is greater with a resin of ***higher molecular weight*** – that is, lower melt index.



Then why not use low melt index resins? Because production rates are lower. The processor must make a compromise between peak production rate and top stress-crack resistance and use a resin that will be satisfactory, if not ideal, in both respects.

Molecular weight distribution of the polyethylene



resin is important too. Resins with a narrow molecular weight distribution (with fewer molecules much higher or lower than the average) have better stress crack resistance than those with wide molecular weight distribution (more of the larger and smaller molecules but the same average). The low molecular weight fraction is more susceptible to attack by environmental materials.

However, the flow properties of a polyethylene resin having a narrow molecular weight distribution and a given melt index are not as good as those of a polyethylene resin having a wide molecular weight distribution and the same melt index. Here again the processor must make a compromise between production rate and the properties he requires in the end product.

Density of the resin will also have an effect on the resistance of that polyethylene resin to environmental stress cracking. The higher the density, the poorer resistance to environmental stress cracking. On the other hand, the more linear or more dense polyethylenes have enhanced flow properties and higher stiffness and tensile strength.

There is no single answer to all problems

It is obvious from the preceding discussion that there is no simple solution to the selection of a resin for a particular end use. The resin must be carefully selected while giving proper consideration to the important end properties required in the fabricated article.

An answer to your particular problem can be found by obtaining a polyethylene resin from a manufacturer who can give you the balance of properties required – high or low melt index, narrow or wide molecular weight distribution, a range of densities. U.S.I. is one such supplier and their Technical Service Representatives stand ready to assist you in the selection of the proper Petrothene resin.

Processing conditions affect stress crack resistance

Processing temperatures, cooling rates, and other processing conditions can have a marked effect on stress crack resistance, because of residual strains left in the fabricated article.

There isn't room to go into these in detail here but the next issue of "Tips" will discuss them more fully.

Meanwhile if you have a specific problem, call on U.S.I.'s Technical Service Engineers. They will be glad to work with you toward finding a solution.

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that wear of parts is considerably reduced below that obtained with conventional lubricants. It is adapted to cash registers used in outdoor markets in extreme climates, typewriters, and high-speed electric calculators which generate considerable internal heat.

Silicone additive for urethane foams

The growth of polyether foams, latest and possibly most promising member of the urethane family, has created interest in a new application for silicone additives which are commonly used to halt or minimize foaming. General Electric Co., Waterford, N. Y., reports that its SF-96 (40), a methyl silicone fluid, is used to stabilize foaming and produce uniformity of cell structure and density; it may also be used to control cell sizes of polyurethane foams.

In polyether foams, the amount of silicone fluid required usually ranges between 0.5 and 1%, but it may be as low as 0.25% of the weight of the foam.

Fatty alcohol ester

A water white and heat stable wax, called Hywax 135, has been announced by Werner G. Smith, Inc., 1730 Train Ave., Cleveland 13, Ohio. The fatty alcohol ester is claimed to change color very little when heated to 290° C. (554° F.) and will tolerate prolonged heating at fairly high temperatures.

Suggested uses include heat stable lubricants for high-impact polystyrene, lacquers, textile finishes and processing aids, rust inhibitors, etc.

Secondary plasticizer for vinyl

A light-colored petroleum product which can be used as a plasticizer with vinyl resins has been announced by Kenrich Corp., 57-02—48th St., Maspeth 78, N. Y. According to the firm, it may be used to replace primary ester plasticizers, such as DOP, by 25%, although this could be modified by an increase of the filler used.

Designated Kenplast, the plasticizer is said to be helpful in obtaining low-temperature flexibility, having a pour point of −55° F. A Fadeometer test for a 100-hr. period indicated that the plasticizer's color stability is good and, therefore, Kenplast may be useful in light-colored stocks as an economical extender. The company does not recommend Kenplast for wire coating which must meet Underwriters' specifications.

Citraconic anhydride

Research and pilot plant quantities of citraconic anhydride are now available from the Commercial Development Div. of Chas. Pfizer & Co., Inc., 630 Flushing Ave., Brooklyn 6, N. Y. This low-molecular-weight liquid anhydride is said to show promise in curing epoxy resins, preparing polyester resins, and serving as a chemical intermediate. The company states that as a curing agent for epoxy resins, the product may find use in epoxide casting and laminating formulations in the electronics, aircraft, automotive, and tool and die industries. Polyester formulations for application in laminates, coatings, and urethane foams can also be prepared with citraconic anhydride.

How to handle foam

The first automated prototype equipment for molding cushions of urethane foam was recently demonstrated at Du Pont's new urethane foam laboratory in Wilmington, Del. The cushion molding line consists of a preheat oven, a station for filling the molds, and a curing oven.

Another piece of equipment in the new laboratory is a molding line, adaptable to practically any mold up to a full-size mattress. This line has been especially designed to assist customers in working out mass production techniques for large items. Special slitters for slicing slabs of urethane foam down to ⅛-in. thick and special die-cutting equipment also have been set up in the lab.

A squeeze roll has been provided to break up cells after the molding process has taken place and giant curing ovens have been installed for the complete processing of the material.

Techniques for hand spraying and pouring urethane foam are being evaluated in a 12- by 16-ft. booth in the corner of the new laboratory.

Low-temperature plasticizer

Plastolein 9078 LT plasticizer for vinyl, designed to meet the need for a low-temperature plasticizer in the adipate price range, has been developed by Emery Industries, Inc., Cincinnati, Ohio. Compared to adipates, the new plasticizer is claimed to offer better low-temperature flexibility as measured by the Masland Impact and Clash-Berg tests, extended permanence, and to possess higher efficiency and substantially greater compatibility.

Applications include use in vinyl sheeting and coated fabrics for outdoor upholstery and outer wear, extruded items, and industrial tapes.

Plastics Institute

Society of Plastics Engineers, Inc. announces that plans are being developed for the formation of a Plastics Institute which will provide facilities for research, both fundamental and development, education for those in any branch of the industry, and a library for reference and study. All segments of the plastics industry will be invited to participate in the program.

Jerome Formo, director of plastics of Minneapolis-Honeywell Regulator Co., has been appointed chairman of the Plastics Institute Committee. Chairmen of the subcommittees are as follows: Charter and Name—Eugene C. Quear; Administrative and Operating Policy—J. H. DuBois; Location and Affiliation—Dr. Gordon M. Kline; Finance and Budget—Haiman S. Nathan; Organization and

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Personnel—William O. Bracken; Liaison—Jean O. Reinecke; Research Projects—Dr. Frank C. McGrew; Library—Arnold M. Varner; Public Relations—Allan A. Hutchings; and Patent—Professor Louis F. Rahm.

For further information on the institute and its objectives, address Jerome Formo, Chairman of the Plastics Institute Committee, 2753 Fourth Ave. S., Minneapolis 8, Minn.

New plastics sign manufacturer

Chain Store Promotions, Inc., 900 Mall Bldg., 4th and Chestnut Sts., Philadelphia 6. Pa., a recently organized firm, will function as designer, consultant, and manufacturer of plastics storefront signs, displays, and other merchandising aids.

Officers of the new company are: Ted Lynch, formerly with Rohm & Haas Co., president; Jules Bellak, president of ABC Plastics Fabricators, Inc., vice president and secretary; and Dewees Showell, vice president and secretary of Mullholland-Harper Co., treasurer. The two firms represented by Messrs. Bellak and Showell have long been manufacturers of the components of plastics signs and storefronts, as well as other types of promotional and advertising devices.

Fluorocarbons

Polyfluoron-coated cable. During the past four years, Liquidometer Corp., Long Island City, N. Y., has successfully been using a polyfluoron-coated coaxial cable in capacitance gages for measuring fuel on North American Aviation fighter aircraft. The coaxial cables are made by Amphenol Electronic Corp., Chicago.

These cables are made with an outer jacket of a fibrous glass braid which is impregnated with polyfluoron by a dispersion dip operation. The resin is then fused into a continuous film by passing the cable through a high-temperature baking tower.

Previously, the aviation fuels would attack the coating on the cable and fibrous glass would then collect in fuel lines, thus plugging them. Since polyfluoron is not soluble in aviation fuels, this problem seems to have been eliminated.

Higher strength at low, high temperatures. Two Kel-F materials, Fluoromat and Fluoroglas, which are claimed to impart higher strength to Kel-F at temperatures approaching absolute zero and greater rigidity at 425°F. and above, are now in pilot production at Fluorulon Laboratories, Inc., Caldwell, N. J. Fluoromat is a laminate of Kel-F, reinforced with finer fiber grids; Fluoroglas depends on reinforcement with 15 to 18% by weight of micro-pulverized glass filaments.

The company states that mechanical properties are improved and low- and high-temperature range is extended through incorporation of glass structures within and integral with Kel-F. The result is a 10-point increase in Durometer "D" hardness to 81 (Rockwell 65, "M" scale), better at room temperature, and doubling the hardness at 300° F. at 52. No measurable distortion is effected until 465° F., compared with a maximum service temperature of 390° F. for virgin Kel-F. Some Fluoroglas parts are said to have operated under load at near absolute zero without exhibiting brittleness.

According to the firm, materials of this type have proved effective as liquid nitrogen, oxygen seals, high-temperature diaphragms, with other uses foreseen in the chemical, mechanical, and electronics fields.

Fluoroglas is available as a translucent-flexible or opaque-rigid material, depending on thickness, which starts at 0.008 inch. Fluoromat is rigid and translucent to opaque, depending on thickness, which starts at 0.0312 inch. Both materials are presently limited to 1-sq. ft. sheets, with 2 by 2 ft. planned for the near future.

Cementable Teflon and Teflon adhesives. Teflon tape and sheet, chemically treated on one side so that it can be adhered to a variety of surfaces without the use of mechanical fasteners, has been announced by Chicago Gasket Co., 1271 W. North Ave., Chicago 22, Ill. According to the manufacturer, the material permits the use of thinner gages of Teflon, without sacrificing any of its physical or chemical properties.

Most frequent applications are for corrosion-resistant, heat-resistant, non-ahesive, and self-lubricating coatings, facings, and linings for all types of machinery and equipment. It can also be used as an electrical or thermal insulating material.

The tape is available in standard 12-in. widths, in rolls of any length. The sheet comes in thicknesses of ⅛ to ½ in.; 24- by 24- and 34- by 34-in. sheets can be supplied on special order.

Epoxies

Epoxy molding compound. What is claimed to be the first practical epoxy molding compound is now being manufactured and marketed by the Booty Resineers Div. of American-Marietta Co., Newark, Ohio. Called Tybon 5621-6, the product is a glass-reinforced, mineral-filled material designed to meet many electrical, chemical, and physical requirements typical of epoxies as used in casting, potting, and laminated parts.

According to the company, Tybon 5621-6 presents the following advantages: 1) It is the first epoxy molding compound with an excellent mold release. Mold release agents are not needed; chromed, aluminum, or steel molds are satisfactory. 2) Cure times range from 3 to 10 min. at 300° F., depending upon the thickness and size of the part. 3) Extremely high pressures for molding are unnecessary; most pressures used are in the 1000

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p.s.i. range. 4) No storage problems are involved; the material has been stored for 18 months at 45° F. without noticeable effect. 5) Materials are supplied in short rods or as granules. 6) The new compound has excellent electrical and physical properties, e.g., dielectric constant and modulus of elasticity are superior to most synthetic potting compounds. 7) Tybon 5621-6 has excellent chemical resistance to acids and organic solvents.

Colorless curing agent. Many of the problems associated with the use of dark-colored, staining varieties of hardeners have been overcome by Hardener 929, a non-staining, colorless curing agent now marketed by Furane Plastics, Inc., 4516 Brazil St., Los Angeles 39, Calif. It is claimed to permit the development of high-temperature epoxies. When cured with appropriate epoxy resins, such as Epocast 10 at 300° F., Hardener 929 will develop heat distortion temperatures of about 300° F.

Fields of application include high-temperature tools, such as bonding jigs and fixtures for aircraft and welding equipment for metal industries, as well as high-temperature electrical service and maintenance functions.

Sample kit. A new epoxy potting compound for use in the electronics industry is being offered in sample kits by Minneapolis-Honeywell Regulator Co. Designated Sealcast 502, the compound was developed to meet the company's special encapsulating requirements and is now being manufactured for sale to other electronics firms.

The compound, a low-coefficient-of-expansion material, is said to exhibit high electrical resistance at temperatures up to 350° F. It has a wide variety of applications in the missile and aircraft industries, including the potting of transformers, magnetic amplifiers, transistors, circuit boards, and recording heads.

Sample kits, including resin and a patented hardener, may be procured for $8 from Minneapolis-Honeywell Plastics Laboratory, 2753 Fourth Ave. S., Minneapolis 8, Minn.

Reinforced plastics

Corrosion-resistant panels. Corrugated structual panels, specially formulated of fibrous glass-reinforced polyester resin to be highly resistant to corrosion, are being produced by Resolite Corp., Zelienople, Pa., which test-installed Metal Grey panels in the North Little Rock, Ark., fertilizer plant of Olin Mathieson Chemical Corp. over three years ago.

High concentrations of ammonia and sulfuric acid fumes above the fertilizer mixing units had necessitated regular replacement of the standard metal roofing and siding panels about every 2½ yr., but the new polyester panels are said to be as good as when they were installed and, it is felt, they will probably last at least five years more. A 3-months' test in a 3% solution of sulfuric acid showed little or no structural changes, the company reports.

The panels are a dull metallic grey and thoroughly opaque, are slightly higher in price than Resolite's standard translucent plastics panels; and are currently available in smooth finish in 2½-, 2.67-, and 4.2-in. corrugations in either standard or extra heavy weight. They can also be supplied in "Fire-Snuf," a special fire-resistant formulation.

Fine strand roving and mat. More rapid and complete resin wet-up, improved bonding of molded parts, and a superior surface finish are said to be possible with a line of Super-Fi fine strand roving and mat produced by Owens-Corning Fiberglas Corp., New York, N. Y. Initial products in the line, R-600 roving and M-506 mat, are now available commercially. They are claimed to have a more uniform fiber distribution, resulting in a more efficient use of glass content and, therefore, provide more uniform strength throughout the molded piece.

R-600 roving is intended for molding of appliance parts, housings, automotive parts, hand luggage, and corrugated reinforced plastics sheets. In corrugated sheeting production, R-600 roving or M-506 mat provides smoother surface and increased weatherability.

The company states that where the end product requires a painted finish, such as an auto body or appliance housing, sanding operations can be cut down with the use of these materials, thus reducing labor costs.

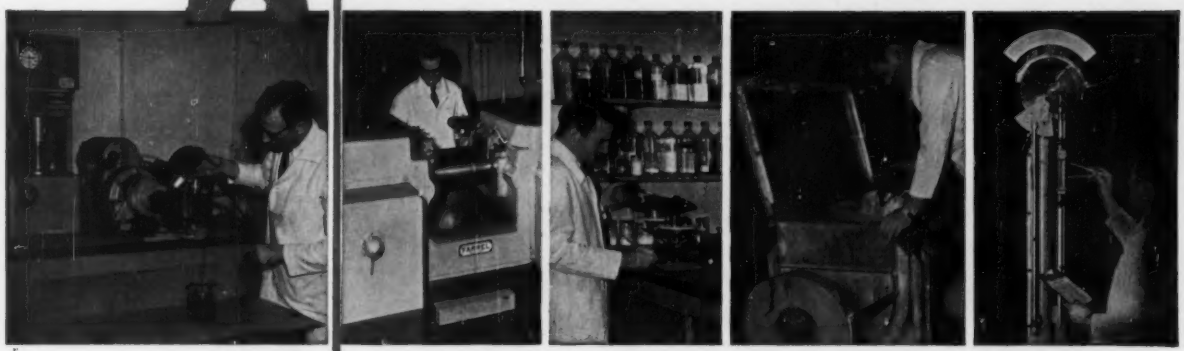
M-506, designed for mat-using fabricators, is claimed to provide better finish and weatherability at approximately the same cost as standard mat. Typical applications for this product are foreseen in the corrugated sheet, automotive, container, and furniture markets.

Custom-colored panels. Improved manufacturing techniques, which permit fine color control and make rapid change-over from one color to the other practical and economical, enable International Plastics Corp., Branford, Conn., to offer its fibrous glass-reinforced polyester Ipcor panels in any color desired.

Sold exclusively through New England lumber and building supply wholesalers and dealers, Ipcor panels for roofing, siding, or facing panels are available in varied sizes and finishes—smooth, textured, and frosted—in either flat, corrugated, or stepped designs. The custom-colored panels will be sold at the same price as the firm's standard panels.

New plastics division. Scientific-Atlanta, Inc., 2162 Piedmont Rd., N.E., Atlanta 9 Ga., fabricator of plastics materials, particularly for electronic and microwave applications, has entered the reinforced plastics fabrication field and has

A. Schulman, Inc. answers today's biggest plastic question . . .



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processed vinyl and polyethylene?

Because they're saving money. Our processed vinyl and polyethylene DO cost less, but at the same time, precise laboratory control assures a product of the highest quality. Working with modern methods and machines, we are able to fill your raw material orders to EXACT specifications, at definite savings to you. HOW?

We maintain complete laboratory equipment of the very latest type, and a staff of highly skilled technicians checks the quality of vinyl and polyethylene we buy, then keeps a constant watch on our processing. Whether you do molding or extruding, we are in a position to handle your requirements . . . just let us know what product you make and give us your specifications.

There is NO GUESSWORK involved — and it COSTS YOU LESS.

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established a Plastics Div. The new division will specialize in components for aircraft, guided missiles, and electronic applications where special or controlled qualities are required. Engineering development and manufacturing services of both thermosetting and thermoplastics materials are available.

Expansion

Alpha Chemical & Plastics Corp., an affiliate of **Rotex Rubber Co.**, Newark, N. J., forecasts an increase of 2 million lb. of reprocessed vinyl and polyethylene by the end of the year over 1956. An additional 10,000-sq. ft. storage area has been acquired to make a larger part of the present 25,000-sq. ft. plant available for new machinery and improved production facilities. A new dry-blending installation was recently completed to further broaden Alpha's line of compounds for molding and extrusion.

Theobaldo Tames, previously director of new products and in charge of plastics extrusions for one of U. S. Rubber Co.'s plants abroad, appointed chief chemist in charge of quality control. **Pascal LaGrutta,** formerly with Lapin Products, named manager in charge of production and engineering and will aid in technical service to molders. The management of Alpha is headed by **Jakob Hirschberger,** president, and **Eric F. Ross,** secretary-treasurer.

Sun Chemical Corp., Long Island City, N. Y., has signed a contract to buy **Ansbacher-Siegle Corp.** The purchase price is 225,000 shares of common stock of Sun Chemical. The contract has been approved by the boards of directors of both companies, subject to the approval of Sun's stockholders.

Ansbacher-Siegle, whose sales exceeded $4 million in the fiscal year just ended, is one of the largest and oldest independently owned organic color pigment manufacturers. The firm's pigments are used in the manufacture of paints, inks, and textile printing colors, all of which products are produced by Sun Chemical. Ansbacher-Siegle also supplies U. S. Government certified colors for the drug and cosmetics industries, as well as colors for the plastics and floor covering industries.

As a division of Sun Chemical, Ansbacher-Siegle will continue to operate under its present management.

Hooker Electrochemical Co. is constructing a research center on a 61-acre site on Grand Island, N. Y. Initial facilities are scheduled for completion by late 1958 or early 1959. The research center, costing approximately $3.5 million, will provide space for about 200 personnel.

The company's **Durez Plastics Div.'s** Basic Plastics Research Laboratory staff will remain at LeRoy, N. Y. In N. Tonawanda, N. Y., the division's plastics development and sales service lab personnel will continue to utilize the $1 million laboratory building, adjacent to the main Durez plant, which was completed last spring.

Wyatt's Plastics, Inc. has expanded its manufacturing facilities with its second plant at Wallis, Texas, 37 miles west of Houston, where it has been in operation for two years. Facilities at Wallis will also permit enlarging output through a new line of combination rubber and plastic parts. These combinations are now in production for services in oil well drilling activity.

Wyatt's Plastics, a wholly owned subsidiary of Wyatt Metal & Boiler Works, has offices and its original plant at 5928 Katy St., Houston, adjacent to the site of the parent company. One activity due for transfer to Wallis from Houston is the production of cleats for football shoes. This was the leading product of Wright Mfg. Co., Houston, whose plastic molding division was purchased in 1955 as the nucleus of Wyatt's Plastics, Inc.

Ciba Co., Inc. is breaking ground for a new 18-million-lb. capacity epoxy resin plant and development laboratories at Toms River, N. J., which is expected to come on stream in mid-1959. This plant will replace Ciba's present Kimberton facility.

Ciba produces basic resins under the tradename Araldite. The company has established nation-wide sales, technical service, and warehouse facilities to assist formulators in adapting the versatile property of epoxy resins to specific application in the automotive and aircraft tooling, structural laminating, protective coatings, solder and adhesives, electric, and electronics fields.

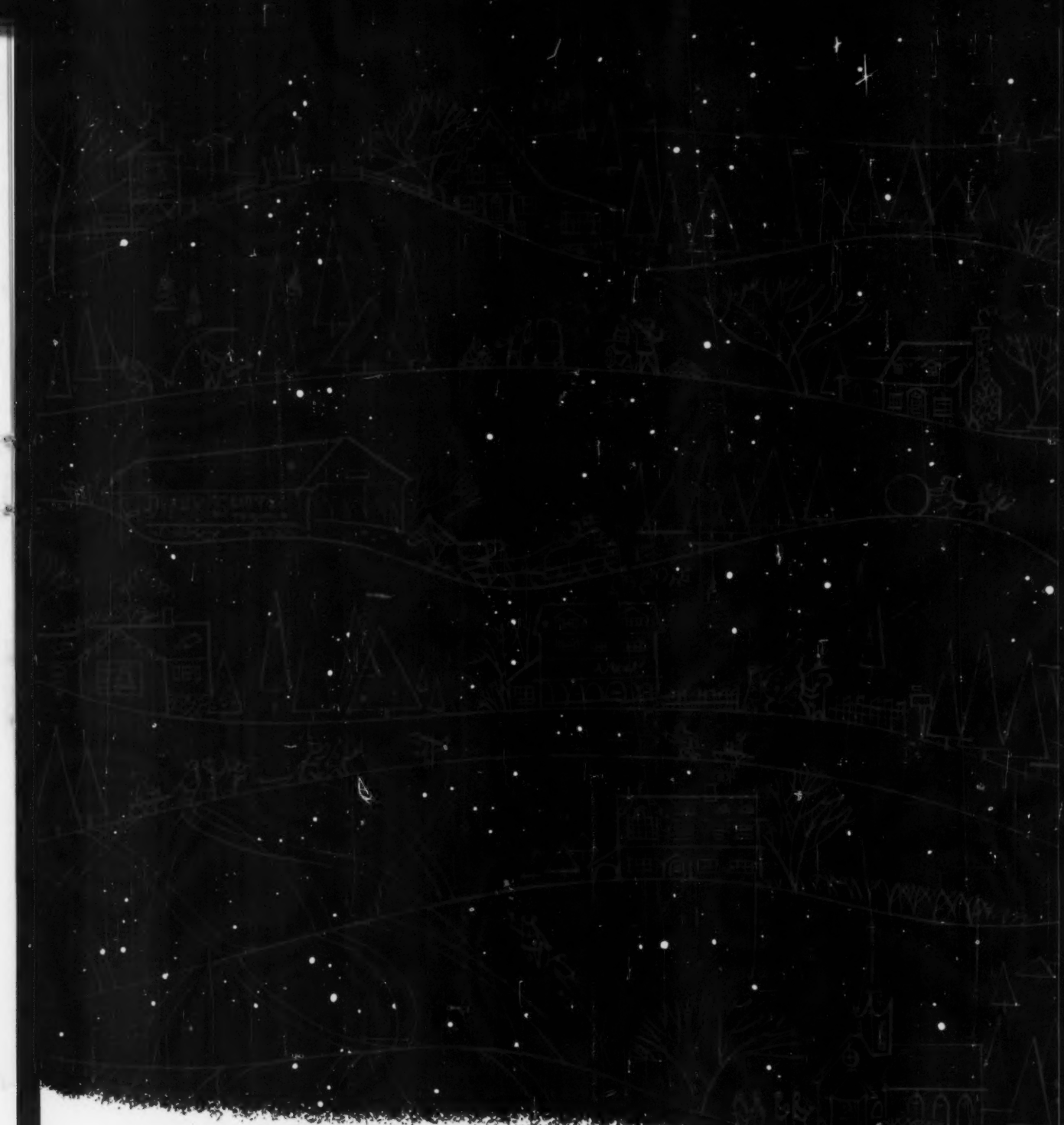
Parker Appliance Co., Cleveland, Ohio, has purchased **Hannifin Corp.,** Des Plaines, Ill., for approximately $7.5 million. The merged companies will operate under the name of **Parker-Hannifin Corp.**

S. B. Taylor is president of Parker. **Elwood G. Peterson,** president of Hannifin, was elected a vice president and director of Parker.

Hannifin makes air power and hydraulic presses and cylinders, as well as components used in liquid, gas, or air pressure systems. Parker products are used to confine or control the flow of gas or liquids under pressure.

Parker-Hannifin operates nine divisions, with plants in Cleveland and Eaton, Ohio; Des Plaines, Ill.; Berea, Ky.; and Los Angeles, Culver City, and Inglewood, Calif. P-H also has 129 distributors in industrial centers.

Kaye-Tex Mfg. Corp., Yardville N. J., manufacturer of Vyflex vinyl upholstery fabric and plastic sheeting materials, is celebrating its 10th Anniversary with the launching of a $1.5 million expansion program. A 40,000-sq. ft. raw-materials warehouse has been completed at the Yardville plant and construction has begun



Season's Greetings

From Witco and its Divisions...

WITCO CHEMICAL COMPANY
Chemicals for Rubber, Paints and Plastics

CONTINENTAL CARBON COMPANY
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WITCO CHEMICAL COMPANY 122 East 42nd Street, New York 17, N.Y.

The Plastiscope

on another 40,000-sq. ft. building which will house finished materials on its second floor.

Installation of a 4-roll plastic calender highlights the company's expansion. The equipment has a roll 28 in. in diameter and 84 in. in length which, according to Kaye-Tex, makes it one of the few manufacturers able to produce materials 72 in. wide. The advanced engineering of the calendering machine and its auxiliary equipment permit the running of both light film and heavy sheeting on the same machine. It will produce a wide range of gages from 0.0025 to 0.035 inch.

Haveg Industries, Inc., Wilmington, Del., has acquired **Lithgow Chemical Co.**, Norwalk, Calif., manufacturer and applicator of chemical corrosion-resistant plastic coatings, cements, impregnations, and laminated linings.

Lithgow will be operated as a division of Haveg. The acquisition has enabled Haveg to expand its line of coatings and to provide new production facilities on the Pacific Coast.

John Dale, Ltd., London, England, leading British manufacturer of collapsible tubes, plastic closures, and metal containers, has acquired **Modern Containers, Ltd.**, Toronto, Ont., the largest collapsible tube company in Canada. With its Canadian subsidiary, **John Dale (Canada), Ltd.**, the English firm expects to serve more than half of the entire Canadian market for collapsible tubes.

Arrangements for the acquisition were completed in Toronto by **W. E. H. Jones**, managing director of John Dale, Ltd., and **J. W. G. Collins**, finance director.

The Borden Co.'s Chemical Div. announces the completion of a one-story office and laboratory building at Leominster, Mass., by its **Polyvinyl Chloride Dept.** The new facility will be operated in conjunction with the polyvinyl chloride resin plant opened at the same location last year. Its main objective is to develop and improve polymers and copolymers of vinyl chloride.

PVC made at Leominster is supplied to various manufacturers of vinyl extruded and calendered products, as well as to Borden's own plants. The vinyl is used by the company for the manufacture of a line of Resinite garden hose and sprinklers, electrical sleeving, plastic tubing, pharmaceutical tubing, shoe welting, and polyvinyl chloride compounds.

The Mead Corp., Dayton, Ohio, and **Hurlbut Paper Co.**, South Lee, Mass., have announced the approval of an agreement for the sale of the assets of the Hurlbut company to Mead. The agreement, which provides for the issuance of Mead shares to Hurlbut, has been approved by the board of directors, but is subject to the approval of Hurlbut's stockholders.

Hurlbut, founded in 1806, primarily manufactures technical papers, including special resin saturating papers used for decorative and industrial laminates in the plastics industry, as well as various types of paper for filtration of air or liquids, and for chemical analysis. The company will operate as a subsidiary of Mead under the same management and with the same production and sales policies as in the past. **E. A. Sitzer** has been president and general manager since 1936.

Plastics Fabricators, Inc. has moved from 401 Chapel St. to its new 100,000-sq. ft. plant at 73 Wallace St., New Haven, Conn. The company also announces that its plant in Havana, Cuba, has been completed and that plans to expand its Chicago subsidiary will go into effect within the next few months.

Officers of the company are: **Stanley E. Berwald**, president; **Joseph DeLise** and **Philip Natenberg**, vice presidents; and **Harold P. Gessner**, secretary. **Burton J. Kahn** is general manager.

The firm is a custom fabricator and manufacturer of industrial covers, household items, sporting goods, etc.

Spencer Chemical Co. has opened a new research center in Johnson County (suburb of Kansas City), Mo., which will be devoted to research and development of new and improved products in the fields of plastics and agricultural and industrial chemicals.

Until recently, the company's principal research facilities were located at its Jayhawk Works, 20 miles south of Pittsburg, Kan.

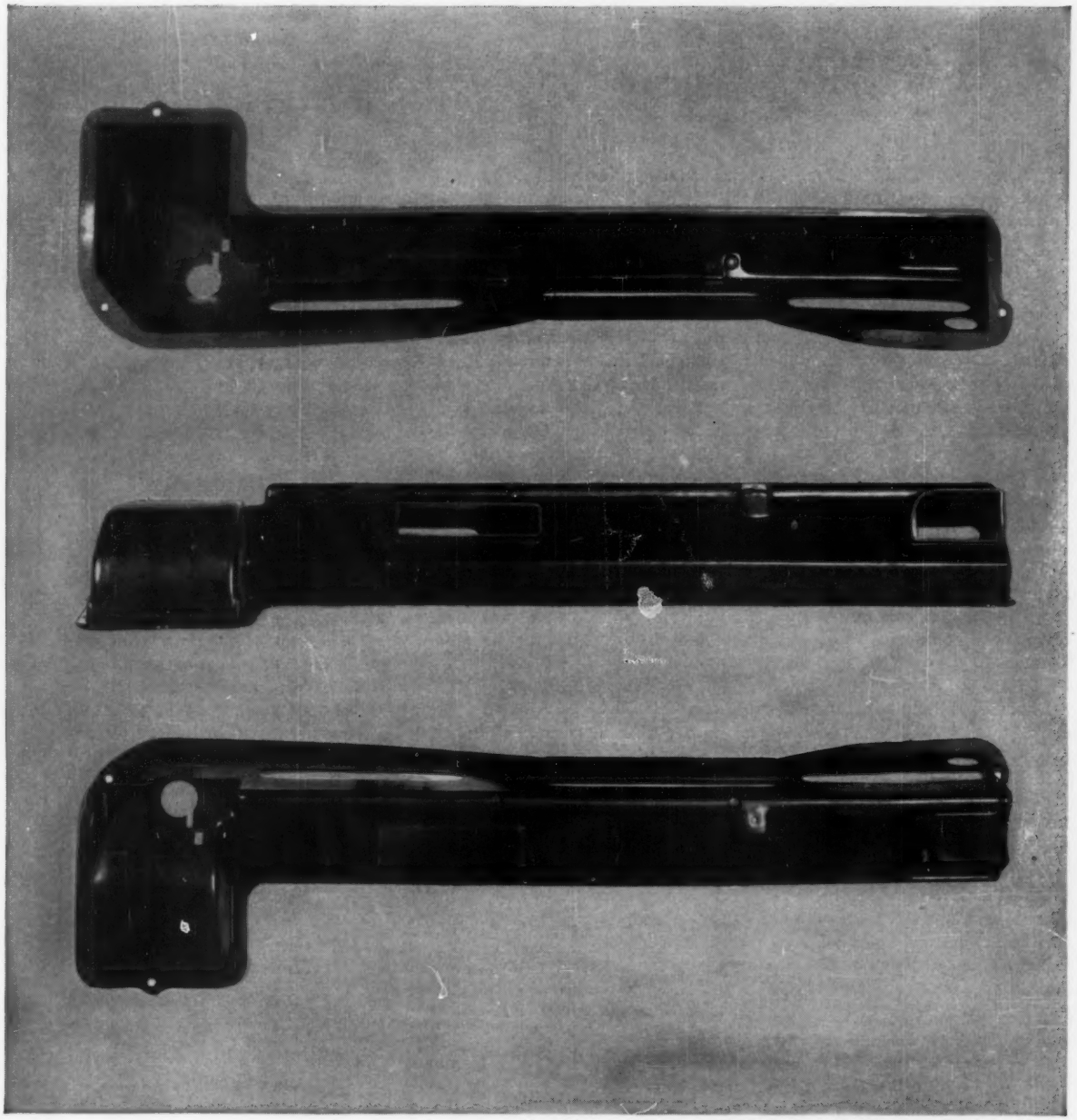
Formica Corp., subsidiary of **American Cyanamid Co.**, announces plans for a 30% increase in production facilities at its Evendale, Ohio, plant. The plant, constructed in 1950, presently occupies an area of about 450,000 sq. ft. and will be increased to more than 550,000 sq. ft. by new construction now getting under way and planned for completion in spring, 1958.

Wagner Brothers, Inc., 400 Midland St., Detroit, Mich., producer of chemical supplies and automatic plating machines, has purchased outright **Automatic Molding Machine Co.**, Los Angeles, Calif., including patent rights to the firm's automatic compression and injection molding presses for plastics.

J. R. Wagner, president, states that the West Coast plant will continue to operate at its present site but that presses will be marketed on a nation-wide scale.

Everledge Mfg., Inc. announces that it is operating at increased capacity in its new and enlarged plant at Jeannette, Pa. The company manufactures a line of phenolic industrial casters, laminated tubing, and electrical, mechanical, and structural components.

Hess, Goldsmith & Co., Inc. has acquired the machinery and equipment of **Wissahickon Asbestos Co.**, Ambler, Pa., manufac-



Heater housing, a premix molding by Woodall Industries, Inc., Detroit, Michigan.

Premix moldings save time, money and trouble

If your product calls for reinforced plastics, you'll save time, money and trouble with premix moldings. Small or large, simple or complex, you'll get quality molding faster and at less cost when resin and reinforcing fiber are blended beforehand.

Premix moldings eliminate resin-rich areas, provide uniform wall thicknesses and strength. They eliminate many finishing operations necessary in hand lay-up molding. Slots, grooves, holes, bosses and parts with varying wall thicknesses are formed in the mold. For strong, rigid, reinforced plastics, premix moldings have proved ideal . . . on the production line as well as in the finished product.

Polyester resin with Dow Vinyltoluene or Dow Styrene offers all the special properties necessary for successful premix moldings. Specify resins based on vinyltoluene—Dow supplies vinyltoluene to resin manufacturers. THE DOW CHEMICAL COMPANY, Midland, Michigan, Plastics Sales Department 1888E-1.

YOU CAN DEPEND ON DOW

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turer of fibrous glass tape. In addition, the Melograna loom patent, named after the designer, Frank S. Melograna, president of Wissahickon, has been assigned to Hess, Goldsmith.

Mr. Melograna will be in charge of manufacturing and development of fibrous glass tape for industrial and other end uses at the **Horace Linton Div.** of Hess, Goldsmith.

Stillman Rubber Co. announces that its **Extruded Products Div.** has moved into a new 10,000-sq. ft. building at 1222 E. Ash St., Fullerton, N. J. The move completes a two-phase expansion program that has increased production capacity by 100 percent. Total factory area now comprises 20,000 sq. feet.

Extruded Products Div., specializing in extruded rubber products, has now entered the field of plastic extrusions.

Bel-Art Products, 4917 Murphy Pl., West New York, N. J., fabricator of polyethylene and other thermoplastics products, has acquired **Dubonnet Products Co.,** custom fabricator, which will operate as the **Dubonnet Acetate Div.** The company has also formed a new Vacuum Forming Dept.

C. Tacopina, president of Dubonnet, and his entire staff are now with Bel-Art.

Wheeling Stamping Co. is constructing a new office building on the site of its Warwood plant in Wheeling, W. Va. The additional facility will enable the company to consolidate its two factory units into one manufacturing operation.

The firm manufactures tin, lead, and aluminum collapsible tubes; molded caps; and plastic specialty items.

Instron Engineering Corp. is building a 25,000-sq. ft. plant in Canton, Mass., for the design and production of universal testing machines and other electronic test equipment. The new facility will also house the firm's administrative and engineering offices. At present, Instron employs over 70 people.

Morningstar, Nicol, Inc., New York, N. Y., which announced last month that negotiations were under way for the acquisition of **Federal Adhesives Corp.** and its affiliates, now reports that arrangements have been concluded and it has acquired the Federal organization. Activities of Federal will be combined with **Paisley Products, Inc.,** Morningstar's adhesive-producing subsidiary. Key personnel of Federal are now members of the Morningstar company.

Electroclor S.A.I.C., Capitan Bermudez, near Rosario, Argentina, announces plans for the construction of a polyvinyl chloride plant. Initial capacity will be 4000 tons annually; provisions for future expansion have been made.

The company states that although the capital required for this enterprise (approximately $3,750,000) will be supplied principally by Electroclor's two main shareholders, **Industrias Quimicas Argentinas "Duperial" S.A.I.C.** (a subsidiary of I.C.I.) and **Celulosa Argentina S.A.I.C.,** it is intended that Argentine investors should in the near future be given an opportunity to purchase shares.

The plant has been designed by Imperial Chemical Industries, Ltd., which will also train the technical staff.

Northwest Plastics, Inc., St. Paul, Minn., announces that its first subsidiary, **Northwest Plastics of Carolina, Inc.,** Gastonia, N. C., has gone into limited production, following completion of the $225,000 molding plant. Eight compression presses and one injection unit, designed and built at the St. Paul factory, are now in use at the new facility, which will service the electric and electronic component industries with intermediate plastic parts used in the manufacture of their products.

Fred T. Thiets, sales manager of the parent company, has been transferred to Gastonia to assume a similar position. He will work under **Russell Diethert,** Chicago district sales manager, in charge of the Carolina sales operation.

Deceased

William J. Dunnican, Union, N. J., died on October 21 at the age of 54, following a short illness. He spent almost 40 years in the plastics industry. Mr. Dunnican's former affiliations were with Garfield Mfg. Co., Reilly Tar & Chemical Corp., Durite Plastics, Synvar Corp., Gordon Chemical Co., Sparta Industries, and Rainville Co. His most recent work was as sales representative for Polyrez Corp. and Hull-Standard Corp.

Mr. Dunnican was a member of the Plastics Pioneer Association, Society of Plastics Engineers Inc., and at one time a member of The Society of the Plastics Industry, Inc.

Dr. Loren Curtis Hurd, 52, president and director of **Metals Disintegrating Co., Inc.,** Elizabeth, N. J., died on September 28 of a heart attack while on a fishing trip. He was an assistant professor of chemistry at the University of Wisconsin from 1925 to 1936; from 1936 to 1955 Dr. Hurd was associated with Rohm & Haas Co. in a research capacity.

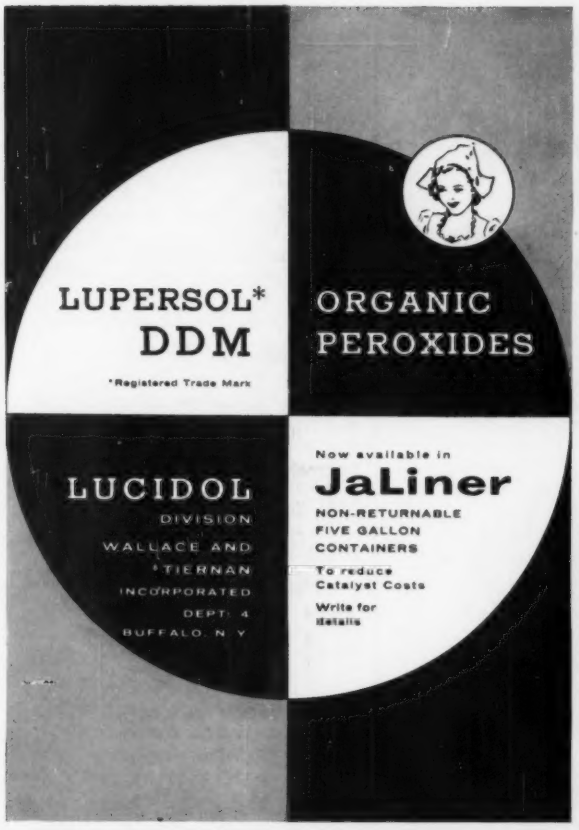
Meetings

Plastics groups

December 10-11: The Society of the Plastics Industry, Inc., Eighth S.P.I. Film, Sheeting, and Coated Fabrics Division Conference, Commodore Hotel, New York, N. Y.

January 28-31: Society of Plastics Engineers, Inc., Fourteenth Annual Technical Conference, Sheraton-Cadillac Hotel, Detroit, Mich. Subject: "Progress Through Plastics Engineering."

February 4-6: The Society of the Plastics Industry, Inc., Thirteenth Reinforced Plastics Division Con-



Molded parts gain unsurpassed clarity of finish in every detail from our process of mirror-finish mold polishing. We check all drafts and tapers, insuring proper radii. Proven procedures assure better cycles, more efficient mold operation and molded parts of super finish. Cost is reasonable, service is prompt. Satisfaction guaranteed.

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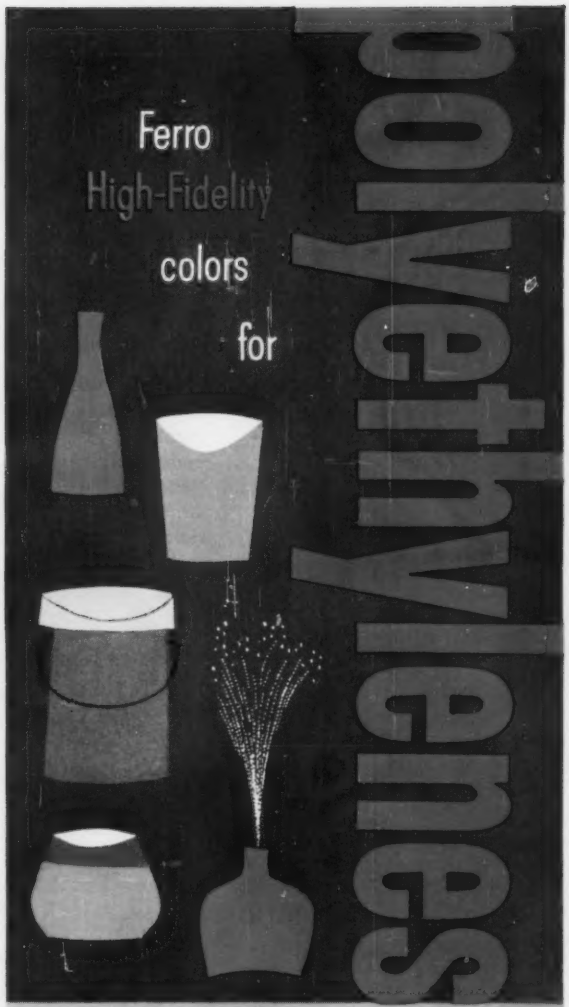

Ferro Colors now make it easy for you to color low-density or the new high-density polyethylenes in your own plant. You can save from $5.00 to $8.00 per 100 lbs. on resin costs. Ferro polyethylene pigments disperse quickly and are non bleeding. With simple equipment you can color mix only the amount of material needed for each order and eliminate scrap or waste. Write today for FREE booklet, *The Technique of Coloring Polyethylene!*

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YOU tell US how to use these remarkable new reinforcing materials!

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FOR EXAMPLE:

This surgeon's bowl had to be unusually abrasion-acid-stain resistant, good looking and able to withstand steam sterilization. Troytuf Dacron was tried and filled the requirements. Result: today these bowls are being manufactured for wide experimental use in U. S. Government field hospitals and institutions.

Your Requirements and Your Imagination Set the Only Real Limits To Troytuf's Uses

What *are* Troytuf reinforcing blankets? Troytuf Dacron and Orlon Blankets are extra-tough, lightweight reinforcing media in that the fibres are tightly interlocked into easily-handled blanket form by a novel needle-punching operation.

Important: In some applications it is even possible to maintain most of the properties and advantages of Troytuf blankets, while using them only as veils and/or overlays.

Which of these Big TROYTUF Benefits Do You Need?

- Higher abrasion resistance than glass
- Better resistance to corrosive mineral acids
- Excellent electrical properties—even when wet
  Exceptional weatherability (Troytuf Orlon)
- Safer material for food, drug-handling machinery and containers
- Smoother, better-looking finish
- Low moisture absorption
- More uniform fiber loading—no resin-rich corners
- Better formability after curing
- Pre-forming eliminated

Why not write us *your* laminating problem. We'll be happy to send you full details and samples for experimental molding.
Troy Blanket Mills, 200 Madison Avenue, New York 16, N. Y.

REINFORCING **Troytuf** BLANKETS

*Dupont trademark

ference, Edgewater Beach Hotel, Chicago, Ill.

March 26-28: The Society of the Plastics Industry, Inc., Pacific Coast Section, Fifteenth Annual Conference, El Mirador Hotel, Palm Springs, Calif.

Other meetings

January 16-23: Nat'l. Housewares Mfg. Assoc., 28th Nat'l. Exhibit, Chicago, Ill.

February 6: The Chemical Market Research Association, Joint Meeting with Chemical Buyers Group, Sheraton-Park Hotel, Washington, D. C.

Encyclopedia corrections

Claremould Plastics Co., Newark, N. J., was omitted from the *Injection Molders Section,* p. 1074.

Continental Oil Co., New York, N. Y., was omitted from *Plasticizers* under the classification V. *(Secondary Plasticizers)* p. 1036.

Madan Plastics, Inc., Cranford, N. J., was omitted from the following sections: *Custom Molders,* p. 1074 (inj. molding; machines range from 2 to 36 oz.); *Sheet Formers,* p. 1102; and *Specialized Services,* p. 1059 (post-molding operations, e. g., spraying, etc.)

Minnesota Plastics Corp., St. Paul, Minn., was inadvertently listed as Minneapolis Plastics on p. 1080, *Custom Molders.*

Molded Fiber Glass Body Co., Molded Fiber Glass Co., and **Molded Fiber Glass Sheet Co.,** all of Ashtabula, Ohio, were omitted from the *Reinforced Plastics Processors Section,* p. 1094.

Rostone Corp., Lafayette, Ind., was omitted from the *Custom Molders Section,* p. 1074. "Rosite," (cold-molded plastic), was omitted from the *Directory of Trade Designations,* p. 1119.

Rona Laboratories, Inc., is located at E. 21st and E. 22nd Sts., Bayonne, N. J. The company was inadvertently omitted from the *Materials and Chemicals Section* under *Pearl Essence,* p. 1036, *Color Dispersions in Resins and Plasticizers,* p. 1028, and *Colorants for Dry Coloring,* p. 1029.

Fife Manufacturing Co., P. O. Box 878, Oklahoma City, Okla., was omitted from the *Handling Devices for Plastic Sheet & Film* category, p. 1052.

Companies . . . People

Union Carbide Corp.—Bakelite Co.: R. K. Turner appointed president to succeed **George C. Miller,** who has been named president of **Union Carbide Realty Co.** in charge of the corporation's realty operations. Mr. Turner joined Union Carbide Chemicals Co. at Clendenin, W. Va., in 1924; he was appointed vice president of Bakelite in 1952. Mr. Miller started with Union Carbide's Linde Co. in 1922. He did early plastic research development for Union Carbide Chemicals and was advanced to vice president of sales for Bakelite in 1952 and president in 1953.

Bound Brook, N. J., plant: **Louis L. Carpenter** named assistant director of the newly created Process Div. in the Development Laboratories, which will be responsible for the operation of development process equipment. **Joseph F. Rocky** appointed assistant director in charge of the Extruded Products Div. at the labs. **Thomas F. Archer,** with the company since 1941 and previously head of the Planning and Scheduling Dept., now assistant superintendent in charge of quality control. He succeeds **Calvin O. English,** transferred to the Visking Co. plant at Terre Haute, Ind., as administrative assistant to the plant superintendent. **Wallace B. Tibbets,** formerly assistant division leader of packaging, now assistant director in charge of packaging at the labs. **George H. Morton** now a group leader in charge of the Surfacing and Printing Group of the Packaging Div.

Union Carbide Development Co.: H. F. Robertson, with the company since 1926 and previously manager of technical planning for Bakelite, appointed technical director.

Union Carbide Chemicals Co. has moved its New Orleans, La., district sales office from 233 St. Maurice Ave. to 4833 Conti St.

Du Pont Co.—Polychemicals Dept.: The Plastics Sales Div. has formed a special program and planning group in an effort to answer basic questions aimed at aiding in the growth of Du Pont's customers and their businesses. Program managers will represent customer groups, determine customer needs for new compositions, and advise on the kinds of promotional and advertising support needed. The planning group will be directed by newly appointed assistant sales managers: **Gerald T. Borcherdt,** formerly manager of the marketing analysis section, will direct programs; **Bailey H. Barnes,** previously assistant manager of plastics sales, will work with field personnel.

Alfred C. Webber, with the company since 1942, promoted from research physicist to senior supervisor. He will continue his work in the field of physical measurements on polymers and plastics. **Dr. A. J. Gordon Allan,** formerly research chemist for Imperial Chemical Industries, Ltd., advanced from a chemist to research associate. He will continue his research studies on the surface properties of polymers.

Film Dept.: H. Lloyd Taylor, with the company since 1950, appointed advertising and promotion manager to succeed **Leroy B. Steele,** who plans to retire at the end of the year.

Goodyear Tire & Rubber Co. New Products Dept. has been established with the function of stimulating new product ideas and speeding up and supporting decisions for the initiation and progress of such projects. Heading up New Products will be a director, and reporting to him will be three administrators of the basic functions—finance, marketing, and technical. Technical representatives, to be added as required, will report to the technical director.

M. J. DeFrance, with the company since 1929 and formerly manager of Chemical Materials and Products Development, appointed director of the new department. Administrators named are: **H. J. Bliss,** finance; **C. B. Marks,** marketing; and **C. T. Wittl,** technical.

Allied Chemical & Dye Corp.—National Aniline Div.: Albert E. Cleghorn appointed president to succeed **Donald G. Rogers,** who has retired after 42 years with Allied and predecessor companies. Mr. Cleghorn joined the company in 1933 and since 1954 was executive vice president.

General Chemical Div.: Mark M. Biddison, former president and consultant on special assignments for the past two years, has retired after 40 years' service with the company.

Solvay Process Div.: A. Gregg Noble, formerly manager of Solvay's Mutual Chromium Chemical plant at Baltimore for 11 years, appointed assistant to the director of operations.

The Dow Chemical Co.—Plastics Sales Dept.: Fabricated Products Section formed which will include four product groups—film and sheeting, Styrofoam, saran fabricated products, and Saran Wrap. **W. L. Nelson,** with the company since 1936 and responsible for Dow plastic film sales activities since 1955, will head the new section.

The film and sheeting group, headed by **L. E. Fake** as product manager, will handle flexible packaging materials for such products as meats, candy, and cheese. The Styrofoam group, under product manager **J. H. Pearce,** will handle foamed plastics materials for construction, insulation, buoyancy, packaging, and novelty applications. Saran fabricated products, headed by **E. E. Chamberlin,** include saran-lined pipe and fittings, Saraloy flashing, and Dowpac for waste-disposal filter elements. Saran Wrap for home and commercial use will be supervised by produce manager **J. K. Stewart.** A re-organized merchandising group, with **J. S. Ryan** as supervisor of fabricated products, will complement the section.

United States Rubber Co.: John W. McGovern, formerly executive vice president, elected president and chief operating officer. He succeeds **H. E. Humphreys, Jr.,** who continues as chairman of the board and chief executive officer. **Eugene A. Luxenberger** and **George R. Vila** named group vice presidents. Mr. Luxenberger, formerly vice president and general manager of the Footwear and General Products Div., will be responsible to the president for the operation of the Footwear and General Products, Mechanical Goods, and Tire Divs. Mr. Vila, formerly vice president and general manager of the Chemical Div., will be responsible to the president for the operation of **Dominion Rubber Co., Ltd., Latex Fiber Industries, Inc.,** and the Chemical, Textile International, and Plantation Divs. **Earle S. Ebers** succeeds Mr. Vila as vice president and general manager of the Chemical Div.; **C. William Pennington** named vice president and general manager of the Footwear and General Products Div. to succeed Mr. Luxenberger; **Edwin A. Martin** appointed assistant general manager of the division. He was formerly plant manager of the Chicago, Ill., plant where Royalite thermoplastic material is made.

Foster Grant Co., Inc.: Four new vice presidents elected: **Jacob Chatkis,** vice president and secretary; **Dr. Sidney J. Baum,** vice president in charge of plastics development and production; **Milton W. Bernstein,** vice president in charge of sales for the Molded Products Div.; and **Dr. F. Drew Mayfield,** vice president in charge of the monomer plant at Baton Rouge, La. Mr. Chatkis, with the company since 1940, was formerly clerk of the corporation. Dr. Baum joined the firm last year as general manager of the Polymer Div. He was co-founder and president of American Polymer Corp. and American Monomer Corp. until these companies were acquired by The Borden Co. in 1953. Mr. Bernstein joined the firm's New York office in 1936 and subsequently became sales manager of the wholesale proprietary products in 1951 and general sales man-

(To page 280)

What they're **both** saying about new Lustrex* Hi-Test 88B

Both extruders and formers have found Lustrex Hi-Test 88B extrusion-grade is an extremely versatile high impact styrene compound. It answers the extruder's need for a material that can produce sheet particularly qualified for vacuum forming high-grade lighting fixtures, packaging, toys or industrial applications requiring high-impact strength. For complete technical information, write Monsanto Chemical Company, Plastics Division, Room 1770, Springfield 2, Mass.

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"Fast Extrusion . . .
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"We like the fast rate at which Lustrex Hi-Test 88B can extrude sheet on standard machines."

"Uniform dry colorability."
"Excellent gloss in all colors . . ."
" 'whiter' whites . . ."

"The sheet has a smooth finish . . ."
"free from streaks, fish-eyes . . ."
"more re-usable scrap . . ."

"Complex shapes with no loss of strength . . ."
"Deep draw molding with no sacrifice of wall thickness or toughness . . ." "Sharp detail . . ."

"Excellent flow. Sheet fills out mold very uniformly."
"Minimum blow-outs in deep drawing."

"Formed product has uniform thickness and residual strength."
"Good dimensional stability facilitates assembly operations."

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PLASTOFLEX ESO and **PLASTOFLEX EET** . . . two new **ADVANCE** products with a single thought – to help you impart heat stability – improve the performance of both the stabilizer and the conventional plasticizer . . . all at very reasonable cost.

PLASTOFLEX ESO

Epoxidized soya type plasticizer–low migration and extractability, with high epoxy content. Prevents any sudden degradation of the vinyl compound which employs zinc in the stabilizing system . . . improves stability. Recommended for vinyl foam, coated and calendered sheeting, garden hose, floor tile–and in Plastisols and Organosols (in which it imparts excellent viscosity).

PLASTOFLEX EET

Ester type epoxy plasticizer . . . extreme low temperature flexibility . . . efficient stabilizing action . . . imparts excellent color stability to vinyl compound . . . prevents any sudden degradation of the vinyl compound which employs zinc in the stabilizing system. Recommended for garden hose, film and sheeting for use at low temperature, slush molding compound, jacket and insulation stocks.

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Companies . . . People

ager for all proprietary outlets in 1953. Dr. Mayfield, with the firm since 1953, played an important role in the designing and construction of Foster Grant's Baton Rouge monomer plant and has been its manager since it opened in 1954.

Arnold B. Finestone, formerly research chemist and group leader of Westinghouse Electric Corp., named senior research chemist.

Diamond Alkali Co.: Raymond F. Evans, chairman and chief executive officer, resumes the office of the presidency, which he had held from 1947 to 1954, upon the resignation of **John A. Sargent** as president and a director of the company. He will also continue as chairman and chief executive officer. **A. H. Ingley,** senior vice president, promoted to the newly created post of executive vice president.

Cary Chemicals, Inc.: Thomas Zawadzki appointed vice president in charge of sales and a member of the board of directors. Other officers include: **George F. Blasius,** chairman of the board and treasurer; **Kenneth B. Cary,** president; **Irving T. Brennan,** vice president; **Cameron I. Kay,** secretary; and **Albert Galuchie,** controller. **Phillip Scarito** and **James A. Hahn** named works managers of the Milltown and Flemington, N. J., plants, respectively. The company is a producer of polyvinyl chloride resins.

National Vulcanized Fibre Co.: Linwood A. Walters, formerly development manager of the Durite Dept. of Borden Co.'s Chemical Div., named to the newly created post of manager of research and development. **Joseph G. Beasten,** with the company 30 years, appointed manager of the Philadelphia district office. He succeeds **Thomas B. Baldridge,** retired after 44 years of service.

The company has been licensed by **The Polymer Corp.,** Reading, Pa., to produce nylon rod under Polymer's patents covering the continuous extrusion of polyamide in elongated dies.

The Borden Co.—Chemical Div.: Herbert R. Erickson now development manager of the Resinite Dept. He comes to Borden from Boeing Airplane Co., where he developed and coordinated specifications in the fields of plastics, adhesives, and sealants. The Resinite Dept. produces polyvinyl chloride extrusions used for electrical sleeving, garden hose and sprinklers, medical tubing, etc. **S. Robert Sweet** and **John A. Bushee** now with the Coatings and Adhesives Dept. Mr. Sweet assigned to the department's sales staff and will handle

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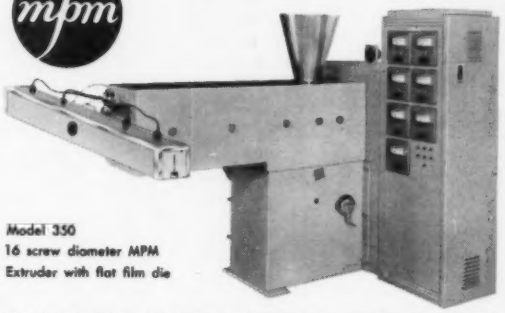

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16 screw diameter MPM
Extruder with flat film die

This latest MPM 3½" extruder, incorporating new bearing assembly, with matching flat film die and takeup, is the most advanced and efficient unit of its kind available to the industry. Film can be produced with tolerances as close as .0001" across a sheet .00125" thick. In actual verified production, film up to 58" wide has been produced at the rate of over 200' per minute. The unique die design makes it possible, with extra capacity MPM extruders and takeups, to produce sheet up to 100" wide.

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Typical of the 45 industries that comprise this rich market are companies which manufacture and package foods, cosmetics, chemicals, drugs, candies and tobacco products. In all these highly competitive industries frequent packaging changes are the order of the day. Factors ranging from fascinating sales appeal to plain hard costs influence the men who make the packaging decisions. Consequently, no one type of packaging material (glass, metal, paper or fabric) ever has assurance that it won't be supplanted by another.

And now plastics have entered the arena as directly competitive materials for packaging. In just the last few years they have come to play an increasingly important role—and often at the expense of older, "traditional" materials.

Especially noteworthy is the fact that plastics can be used in the manufacture of almost every basic package type: box, bag, bottle, drum, jar, vial or collapsible tube!

Right now this frontal invasion of the packaging field by alert plastics manufacturers, molders, laminators and fabricators has just begun. And their chief sales tools are the two publications which reach the men who make packaging decisions in all 45 industries—MODERN PACKAGING magazine, issued monthly, and the annual MODERN PACKAGING ENCYCLOPEDIA ISSUE.

Free Details about the Market

Additional data on using these media to help expand your sales to the packaging market are contained in the booklet "The Packaging Field—and how to reach it." Write for your free copy.

•

MODERN PACKAGING

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Companies . . . People

Placco-brand building materials in the Philadelphia area. Mr. Bushee, formerly with General Latex Chemical Corp., will be at Borden's Latex Laboratory in Peabody, Mass.

Tracerlab, Inc.: Dr. David Bandel named associate technical director, succeeding **Dr. William Tittle**, resigned. Dr. Bandel comes from American Machine & Foundry Co., where he served as manager of the Chemical Research Div. and as special technical assistant to the vice president of the Commercial Development Div. **Carl Woodrow Hansen**, formerly with General Electric Co., named chief engineer of the Industrial Products Div. **Paul A. McNulty**, formerly with Boston Woven Hose & Rubber Co. and American Cyanamid Co., appointed administrative assistant. He will work on new product development in plastics, paper, rubber, medical research, etc.

Swedlow Plastics Co., Los Angeles, Calif., has been licensed by **Solar Aircraft Co.**, San Diego, Calif., to manufacture and sell its resistance-welded stainless steel honeycomb core in the United States and Canada. Swedlow, which is currently manufacturing aluminum core in its Los Angeles plant, will have exclusive rights to Solar's honeycomb core processes and machinery. Solar retains rights to make core for its own needs and is extending its activities in the development and manufacture of stainless steel honeycomb sandwich structures.

The new agreement is Swedlow's second major step in the honeycomb field this year. In February, the company acquired all facilities, techniques, and patents of Honeycomb Structures Co., Inc.

Phillips Chemical Co., subsidiary of **Phillips Petroleum Co.**: The following sales engineers have been appointed to the staff of the Plastics Sales Div.: **A. R. Beckett**, Pasadena, Calif.; **C. J. Silas** and **F. C. Blue**, Bartlesville, Okla.; **R. V. Porter** and **C. H. Luling III**, Elmhurst, Ill.; **L. A. Grundy**, E. Providence, R. I.; **C. R. Loden, R. F. Lynch**, and **F. M. Jackson**, New York, N. Y.; and **A. C Levinson**, Akron, Ohio.

Wallace & Tiernan, Inc.: Robert T. Browning with the company since 1930, appointed executive vice president. He was formerly vice president, directing sales activities of the firm's three chemical divisions and sales and engineering activities of the five equipment divisions and subsidiaries.

Lucidol Div.: A. I. Andrews, with the company 23 years and formerly manager of the Philadelphia division office, named assistant general manager. The company manufactures various chemicals, including organic peroxide compounds used in the plastics industries.

The C. P. Hall Co., 414 S. Broadway, Akron 8, Ohio, chemical manufacturer, has established a Machinery Dept. to handle the sales of **Erie Engine & Mfg. Co.'s** line of mills, presses, loaders, preform machines, roving cutters, etc. in Ohio. The machinery and equipment are used in the plastics, fibrous glass, and wood products industries. Hall has been representing Erie on the West Coast for the past three years.

Association of Consulting Chemists and Chemical Engineers, Inc.: Following officers elected for a one-year term: President—**Lincoln T. Work**, consulting chemical engineer, New York, N. Y.; vice president—**Abraham Taub**, consulting chemist, College of Pharmacy, New York, N. Y.; secretary—**Charles Davidoff**, consulting metallurgical engineer, New York, N. Y.; and treasurer—**Sam Tour**, Sam Tour & Co., Inc., New York, N. Y., consulting chemical and metallurgical engineers.

General Electric Co.: John T. Castles, formerly manager of rubber market development, now sales manager of the Silicone Products Dept. He succeeds **Jerome T. Coe**, named marketing manager of the department.

American Cyanamid Co.—Pigments Div.: Philip G. Connell, Jr., with the company since 1946 and formerly manager of the Rubber Chemical Dept., Organic Chemicals Div., appointed assistant general manager. **John H. Dietze**, formerly manager of export and sales development, named central regional sales manager, with headquarters at 3505 N. Kimball Ave., Chicago, Ill. He replaces **Kenneth A. Coate**, transferred to a sales assignment in Los Angeles, Calif.

Pittsburgh Plate Glass Co.: Edwin T. Asplundh, formerly president of its subsidiary, **Columbia-Southern Chemical Corp.**, elected board chairman of both companies. **Joseph A. Neubauer** succeeds Mr. Asplundh as president of Columbia-Southern.

Continental Diamond Fibre of Canada, Ltd. is the new name of the company formerly known as Diamond State Fibre Co. of Canada, Ltd. The name change was made to permit closer identity with **Continental-Diamond Fibre Corp.**, Newark, Del., a subsidiary of **Budd Co.**, manufacturer and fabricator of plastics laminates, vulcanized fibre, and products for the electrical insulation and electronics industries.

St. Regis Paper Co.—Panelyte Div.: Charles L. Walters appointed assistant general sales manager. He has been associated with Panelyte since 1940 and was Canadian manager of the division at St. Jean, Que., from 1950 to 1953. **William R. Sievert**, with the firm since 1949, transferred from the Chicago office to succeed Mr. Walters as sales manager of decorative Panelyte plastics in New York City.

American Molding Powder & Chemical Corp.: Roy Sorenson, formerly production manager, appointed vice president of manufacturing; **Alvin Emory**, previously controller, now treasurer; **Edward J. Babis** named administrative assistant to the executive vice president and general manager, **M. Pisetzner.**

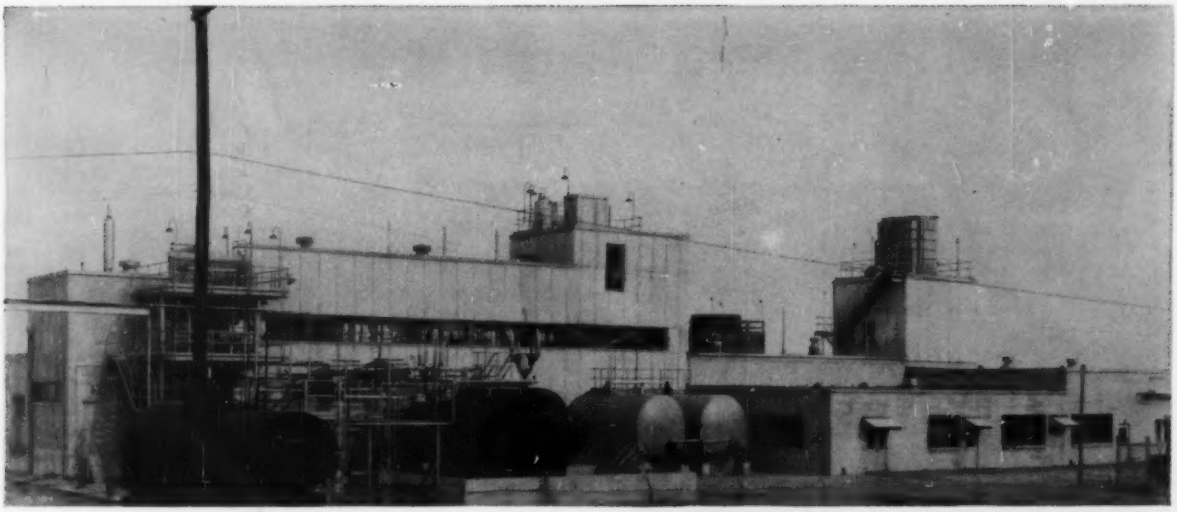
American Viscose Corp—Film Div.: Melvin K. Barrall and **William F. Mount** named technical control supervisors in the Technical Dept. of the Marcus Hook, Pa., cellophane plant. **Edward C. Clark, Jr.** now head of the Spinning Section, Raw Film Dept.

Carlon Products Corp.: Richard G. Kress, formerly West Coast sales manager, named general manager of the West Coast Div., responsible for management of the recently acquired Los Angeles plant, the Klamath Falls, Ore., plant, and the western territory serviced by these facilities. **Floyd Wilson** appointed production manager; **Jack Price**, sales manager in charge of California, Nevada, and Arizona territories; **Charles Porter** to head sales in the Pacific Northwest area.

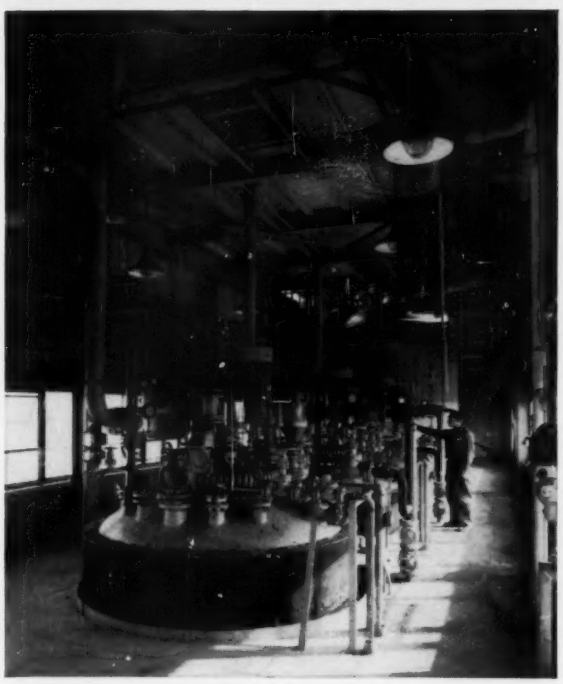
Hooker Electrochemical Co.: Dr. Clarence A. Stiegman named technical director and **Dr. J. Howard Brown** general manager of Niagara research and development. Dr. Stiegman was formerly director of product development and Dr. Brown assistant technical director.

Emery Industries, Inc.: David R. Eagleson promoted to assistant sales manager of the Fatty Acid Sales Dept. **Paul N. Leech** succeeds Mr. Eagleson as Chicago sales representative. **Joseph Z. Sack**, appointed to the newly created St. Louis sales territory for the department, will cover Missouri, Iowa, Nebraska, Colorado, and parts of Illinois, Kansas, Kentucky, and Tennessee.

Federal Tool Corp.: Jack F. Turner, formerly assistant sales manager, promoted to merchandise manager; **Ross Bellamy**, previously with Sales Dept., Housewares Div., now sales manager, National Accounts Sales,



Polyvinyl chloride plant, designed and built for the Insular Chemical Corporation at Hicksville, New York, owned and operated jointly by Ross & Roberts Inc. and Rubber Corporation of America.



Heart of the process consists of reactors equipped with instrumentation for precise control of the process.

How Blaw-Knox builds an idea into a profitable resin plant

The idea: improve production of vinyl film and sheeting by integrating a polyvinyl chloride resin plant into the operation.

The problem: could such a plant be built to deliver the capacity required for profitable performance.

Blaw-Knox was asked to analyze the problem in detail. Their economic and engineering studies proved the idea feasible . . . pointed the way to a pilot plant to determine formulation data.

Then, maintaining close contact with the client, Blaw-Knox moved ahead with plant construction. This program co-ordinated engineering, procurement, inspection, and cost control.

Results: a smoothly running plant delivering specified capacity and quality, stabilizing material flow, widening overall profit margin.

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Companies . . . People

specializing in chain store operations; **Ed W. Goetz** appointed sales manager, National Premium Accounts Sales and **Norman R. Nielsen** sales manager of Premium Sales. **Charles F. Beckman**, formerly with Superior Plastic, Inc., named sales engineer, handling sales of custom plastics to national manufacturers.

Cadillac Plastic & Chemical Co. has opened branch units at 1201 Walnut St., Cincinnati, Ohio, and 1517 Grand Ave., Kansas City, Mo., with **William D. Benkelman** and **Stanley Strain** as respective managers. The company now operates warehouse-sales office units in 10 cities.

John E. O'Brien, formerly controller, promoted to treasurer and assistant secretary of the company.

Ren Plastics, Inc.: Eugene H. Wiard appointed to head up the newly organized Market Service Div., responsible for advertising, publicity, and public relations. **George M. Kovac**, formerly with Cog Corp., Chicago, Ill., named director of the Engineering Dept. The company manufactures tooling plastics for the automotive and aircraft industries, and has recently developed a plastic solder.

Fabricon Products Co.: Paul Brown appointed technical and quality control director and **Harold Godfrey** plant engineer. Both appointees come from The Richardson Co.—Mr. Brown served for 17 years as chief chemist, manager of product development, and supervisor of technical market evaluating; Mr. Godfrey was with the firm for 10 years and served as process engineer and assistant plant engineer. Fabricon manufactures Lamin-Art, high-pressure plastic laminates.

American Hard Rubber Co. has moved its executive offices and Sales and Accounting Depts. from 93 Worth St., New York, N. Y., to its new office building in Butler, N. J., adjacent to the firm's plant. American manufactures storage battery components, corrosion-resistant chemical processing equipment, industrial parts, etc.

Schering A. G. Berlin, Berlin, Germany, named exclusive distributor of Versamid polyamide resins in western Germany and Austria by **General Mills, Inc.**, Minneapolis, Minn.

National Electronic Plastics, Inc., Matawan, N. J.: **John Anderson** elected vice president, with sales offices at 521 Fifth Ave., New York, N. Y. Following sales representatives named: **William Kelly**, Kansas City, Mo., will cover Iowa, Kansas, Missouri, and Nebraska; **Mike Roth Sales Co.**, Cleveland, Ohio, will serve Ohio, western Pennsylvania, and W. Virginia; **Edwin Schultz Co.**, Indianapolis, Ind., will handle Indiana and Kentucky; **Earl T. Champion Co.**, Chicago, Ill., will cover northern Illinois and eastern Wisconsin. **William Cohen**, Montreal, Que., for Canada; **Don V. Hamilton**, Minneapolis, Minn., and **Fred H. Haight Co.**, Seattle, Wash. **Morhan Exporting Corp.**, New York, N. Y., will handle exports. National manufactures the Electroplast line of high-temperature products—wire, tubing, rods, and custom molded electronic components.

U. S. Industrial Chemicals Co., Div. of National Distillers & Chemical Corp., has moved its Pacific Coast offices from 714 W. Olympic Blvd. to enlarged quarters at 1901 W. 8th St., Los Angeles 57, Calif.

Formica Corp.: District offices have been added in Houston, Texas, and San Diego, Calif., with **Bob Welch** and **Bob Hockaday** as respective district sales managers. The Houston office will cover southern Texas to the New Mexico border; the San Diego office will cover Arizona, San Diego proper, and the Imperial Counties in California. **Peter Wheedon** assigned to the Chicago district sales office.

Ball & Jewell, Inc.: Calmar Industrial Associates, 40 George St., Bristol, Conn., and **Delval Equipment Corp.**, 913 Montgomery Ave., Narberth, Pa., appointed sales representatives. Calmar will cover the New England states and Delval will handle Philadelphia, Pa., Trenton, N. J., and Wilmington, Del. The company manufactures granulators, hopper-heater-dryers, and pelletizers for the plastics and allied industries.

Commercial Solvents Corp. has established a new corporate district office at 344 Williams St., N.W., Atlanta, Ga., with **T. Austin Young** as district manager.

Product Techniques, Inc., Hudson, Ohio, appointed sales representative for Amveco asbestos fiber produced by **World Commerce Corp. S.A.**, Caracas, Venezuela, for the plastics and related industries.

Whitlock Associates, Inc., 21655 Coolidge Highway, Oak Park 37, Mich., is the new name of the company formerly known as **C. H. Whitlock Associates. C. H. Whitlock** is president; **Mary G. Denny**, vice president and treasurer; and **Dick Denny**, secretary. The company manufactures automatic, pneumatic, and vacuum-operated hopper-loaders.

Spear-Newman, Inc., New Haven, Conn., **Formica Corp.**'s Connecticut distributor, has opened a new warehouse at 52 Bell St., Springfield, Mass., and will also cover western Massachusetts.

Tubed Chemicals, Inc., 2 Pine St., Easthampton, Mass., appointed East Coast distributor by **Plastic Packaging Machinery Co., Inc.**, Seattle, Wash., for its line of plastic skin and bubble packaging machinery.

Sarco Co., Inc. and **Sarcotherm Controls, Inc.**, manufacturers of temperature regulators and heating specialties, moved from the Empire State Bldg. to new and enlarged quarters at 635 Madison Ave., New York 22, N. Y.

Harold H. Radke, with the organization since 1940 and formerly development supervisor, appointed development program analyst of **B. F. Goodrich Chemical Co.**, Cleveland, Ohio. The position was created to assist in the selection of research and development projects. Mr. Radke will work in conjunction with **Dr. B. M. G. Zwicker**, director of new products planning.

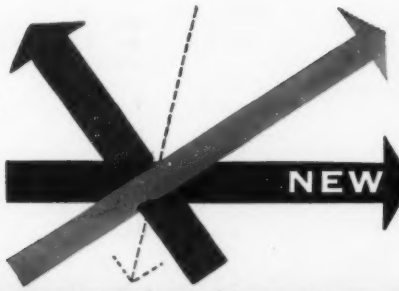
Richard H. Malamphy appointed western contracts manager of **Swedlow Plastics Co.**, Los Angeles, Calif. He has a record of over 20 years in sales in the chemical and plastics industries. Mr. Malamphy formerly was with American Cyanamid Co., Mead Papers, Inc., and recently manager of plastics sales at Naugatuck Chemical Div., U. S. Rubber Co.

R. H. Malamphy

Dr. James C. Kirk, previously research supervisor of the Petrochemicals Div. of Continental Oil Co., appointed director of research of **Petroleum Chemicals, Inc.** at Lake Charles, La. He will report to **Dr. Howard L. Malakoff**, manager of the Technical Dept.

P.C.I. is owned jointly by Cities Service and Continental Oil Companies.

George O. Morrison, assistant to the general manager of **Shawinigan Resins Corp.**, has retired from active participation in company affairs. He will do consulting work and will continue his association with the firm in this capacity. Well known throughout the paint and wire industries, Mr. Morrison discovered polyvinyl acetal resins, including Formvar, the prime ingredient for



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UV 9* ULTRAVIOLET ABSORBER

Light-sensitive polymers are protected from discoloring or degradation by the remarkable ultraviolet-absorbing efficiency of Cyanamid's UV 9 Absorber. Polystyrene light-diffusing panels, for example, are protected from yellowing and cracking through years of exposure to fluorescent lighting – and this protection is extended to every ultraviolet-light-sensitive dye, fabric and finish in the illuminated room. Outdoors, even the sun's most intense ultraviolet radiation is rendered harmless by UV 9. Transparent, translucent or pigmented polystyrenes can keep their clarity or color through years of exposure.

Compounders are finding UV 9 highly effective as a practical stabilizer for polystyrene. It blends in easily, and 0.2 to 0.5% is sufficient to multiply by many times the useful life of plastic products. Full commercial production assures adequate supplies for new users.

Cyanamid's bulletin, "UV 9 Absorber," contains much practical information on UV 9. Your New Products man can bring you up to date on other ultraviolet absorbers developed through many years of pioneering research and on recent application developments.

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Companies . . . People

magnet wire insulation. He is also closely identified with the development of polyvinyl acetate paints.

Dr. William J. Roberts named director of research of the Summit, N. J., Research Laboratories of **Celanese Corp. of America.** He formerly was director of research of Pennsylvania Industrial Chemical Corp.

Richard R. Hydeman elected vice president—manufacturing of **Taylor Fibre Co.,** Norristown, Pa., succeeding **Harold C. Steadman** who has resigned. The firm manufactures laminated plastics vulcanized fibre, and roller copper-clad laminates for printed circuits.

Thomas A. Bissell, formerly with the Society of Automotive Engineers for 21 years, appointed executive secretary of **Society of Plastics Engineers, Inc.**

Robert L. Means, formerly assistant to the vice president, Container and Chemical Specialties Div., named product sales manager for compound-applying machinery of **Dewey & Almy Chemical Co., Div. of W. R. Grace & Co.** The position was created to service the requirements of manufacturers using the firm's high-speed machines which apply "flowed-in" sealing compounds to aerosol mounting cups, tumbler caps, crown caps, etc.

Thomas F. Edson now plant manager of **Dyestuff and Chemical Div., General Aniline & Film Corp.,** at Linden, N. J.

Howard W. Bartlett named manager of paper chemicals of **Pennsylvania Industrial Chemical Corp.,** Clairton, Pa. He will supervise paper industry projects in the plant's laboratories and coordinate technical service through Picco's sales offices.

Lawrence G. Maechtlen, a director and vice president since 1951 and manager of the Western Div., named first vice president of **Square D Co.,** working out of the Detroit executive offices. The company manufactures electrical distribution and control equipment.

Jim Nash, president of **Jim Nash Associates,** elected president of **Package Designers Council.**

John Hackett, formerly sales representative for Monsanto Chemical Co., now assistant sales manager of **Kolker Chemical Corp.,** Newark, N. J. He will handle sales of the firm's plasticizers, methylene chloride, methyl chloride, phosphate esters, tricresyl phosphate, chlorinated solvents, etc.

John Walton Perloff, previously with Godfrey L. Cabot, Inc., now sales development manager for the **Chemicals Div. of Golden Bear Oil Co.,** Los Angeles, Calif. The company recently doubled its manufacturing facilities for its line of products, including plasticizers and extenders for the plastics and rubber industries.

Cornelius Van Horne, formerly with Chester Packaging Co., appointed controller of **Plastics Horizons, Inc.,** Paterson, N. J.

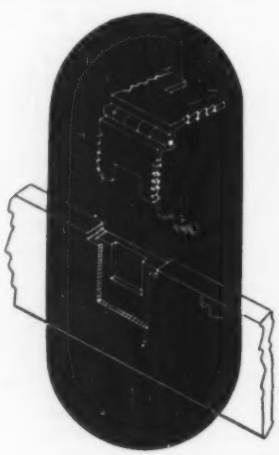
William D. Rohlf, Seaco Associates, 2443 N. Amanda Circle, N.E., Atlanta 6, Ga., appointed southern manufacturer's representative for **Erie Plastics Div.** of **Erie Resistor Corp.**

Elmer J. Collins appointed product development engineer of **Marbon Chemical, Div. of Borg-Warner Corp.,** Gary, Ind.

John F. D'Antonio named manager of the **Board Processes Consulting Div. of Crawford & Russell, Inc.,** Stamford, Conn., plant engineers and constructors. Mr. D'Antonio has designed many of the gypsum board,

HINGES . . .
for PLASTIC BOXES

press-fit assembly
(Holds like
a drive-screw)
with
or without
double action
"C" Springs



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109 LONG AVENUE
HILLSIDE, N. J., U. S. A.

MOLDED
NYLON ROD
in a wide range
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CUSTOM INJECTION MOLDING
of every type Press capacities from 4 ounces to 200 ounces

MOLDED
NYLON SLAB
STOCK

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SOCIETY OF THE PLASTICS INDUSTRY SPI

A. L. HYDE CO.
ESTABLISHED 1932 • GRENLOCH, NEW JERSEY

An easy ride with Sullivan Chemicals

This beautiful molded plastasol horse is one of the herd from the corral of WONDER PRODUCTS at Collierville, Tennessee. A BLUE RIBBON WONDER HORSE that leads the field of hobby horses. Sullivan Chemicals plays an important part in making this Plastasol Pinto a thoroughbred. Vinaplex coatings, specifically formulated for polyvinyl chloride, never crack or peel under the constant flexing of these moldings.

coatings for plastics

Sullivan Chemicals manufacture protective and decorative coatings for all types of plastics. Produced with particular emphasis on adhesion without craze, plus durability, color stability, ease of application and richness of finish for decoration and sales appeal.

ACETAPLEX for Cellulose Acetate
BUTAPLEX for Cellulose Butyrate
METALPLEX for Vacuum metallizing
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PLASTAPLEX for Polystyrene
POLYPLEX for Acrylics
VINAPLEX for Vinyls
MONOTEX a textured finish
SCREEN PROCESS INKS for all plastics

Write for further information and technical data

Vinaplex will last the life of the plastasol with excellent adhesion and resist plasticizer migration under high heat and humidity conditions. Durable VINAPLEX in permanent colors is the quality coating for plastasol. Butyrate, Acetate and now Vinyl horses are decorated with specifically formulated coatings developed for these plastics to give a permanent and beautiful finish.

SULLIVAN CHEMICALS
A Division of SULLIVAN VARNISH COMPANY
420 NORTH HART STREET • CHICAGO 22, ILLINOIS

hardboard, insulating board, and particle board plants in the United States and throughout the world.

Herbert J. Cronin, Jr., previously with The Dow Chemical Co., named sales manager of the **Chemical Div.** of **Great American Plastics Co.** at Fitchburg, Mass. The division produces polyvinyl chloride resin.

William J. Houston, formerly general sales manager, promoted to vice president—marketing of **Nuodex Products Co., a Div. of Heyden Newport Chemical Corp.**, New York, N. Y.

John R. Sunnygard assigned to the Central Research Laboratory in the New Products Development Section of **General Mills, Inc.**, Minneapolis, Minn.

Charles H. Churchill, general manager of **Pacific Polymers**, a subsidiary of American Latex Products Corp., Hawthorne, Calif., elected executive vice president and general manager. The firm manufactures plastics compounds and coatings for the foam rubber, textile, and related industries.

Robert Davis, named midwestern district manager of **Plastics Machinery Div., National Automatic Tool Co., Inc.** will be in charge of sales and service of Natco plastics injection molding machines in eastern Michigan, northern Ohio, western Pennsylvania, and western New York. His headquarters will be at the firm's regional office in Berea, Ohio.

Joe Kempker named sales manager of **Line-O-Coat Industrial Equipment Co.**, Compton, Calif. He will direct national sales activities for the firm, which manufactures corrosion-resistant industrial equipment.

Roland K. Griffith, formerly development manager of The Borden Co.'s Resinite Dept., now affiliated with **Raytherm Corp.**, Redwood City, Calif., manufacturer of irradiated polyethylene products.

Thomas D. McGuire, formerly with Auburn Button Works, Inc., now with the **Chem-o-sol Sales Div.** of **Chemical Products Corp.**, E. Providence, R. I. He will handle the firm's vinyl plastisols in upper New York state and surrounding territories.

Dr. Arnold P. Howe appointed to the newly created post of assistant to the president of **Michigan Chrome & Chemical Co.**, Detroit, Mich.

Alfred A. Lawrence, formerly New England district manager for The Dow Chemical Co., has joined **Charles D. Kellogg Associates**, Salem, Mass., a marketing research and consulting engineering company. He will be in charge of the firm's consulting services to companies in the chemical and plastics fields.

Virgil J. Hostler, with the firm since 1941, appointed eastern district engineer of the Chemical Plants Div. of **Blaw-Knox Co.** He will be responsible for division sales activities in eastern New York, northern New Jersey, and New England.

Peter N. Triano now sales representative of **Interplastics Corp.**, 120 E. 56th St., New York, N. Y. The company supplies thermoplastics molding powders, resins, and raw materials and purchases surplus inventories of molding powders and plastic scrap.

Richard F. Love, formerly with Minnesota Mining & Mfg. Co., has joined the Sales Dept. of **Corrulux Div., L-O-F Glass Fibers Co.**

Robert C. Davenport now sales manager of **Crystal Plastics Co.**, Pawtucket, R. I., custom injection molder and vacuum former. Mr. Davenport was formerly with Lamex Chemical Div., Foster Grant Co., Inc.

Donald M. Ware, formerly with Owens-Corning Fiberglas Corp., has joined **Fiber Glass Industries, Inc.**

Classified Advertisements

EMPLOYMENT • BUSINESS OPPORTUNITIES • USED OR RESALE EQUIPMENT

Machinery and equipment for sale

FOR SALE: (6) 100 ton, 10" ram, 10" stroke @ $1250; (7) 200 ton. 9" stroke, 14" ram, 36x36, @ $2160; (6) 200 ton, 9" stroke, 15" ram, 30x30 @ $1850; (1) ton complete, 18x18 @ $1850; (1) 200 ton 16" ram, 30x30 @ $2450; (2) 200 ton 16" ram, 42x42 @ $2850; (1) 200 ton, 15" ram, 42x42 @ $2600; (3) 250 ton (2) 12" ram, 30x60 rebuilt @ $3675. Hydraulic Sal-Press Co., Inc., 388-90 Warren Street, Bklyn, N.Y.

FOR SALE: All in stock—Glass-lined reactors—30, 50, 100, 500 gal. 1—6"x13" lab. mill. 2—50" mills. 3—4'x7' Vulcanizers, ASME 125# WP, 650° F, Quick-opening doors. 3400 HP Farrel-Birmingham horizontal reducer. 6 oz. Injection Molders—1942 Watson-Stillman, 1947 Lester. Double arm sigma blade mixers—2¼, 5, 10, 20, 30, 60, 75, 100, 150 gal., stainless steel and steel. Rotary & single punch Tablet or Preform Presses—Stokes "R", "T", "DD-2", "RD-4", Kux rotary 21, 25 punch. Perry Equipment Corp., 1429 N. 6th St., Phila. 22, Pa.

FOR SALE: 1-Baker Perkins size 15USE, 100 gal. all stainless double arm Vacuum Mixer; 1-Baker Perkins size 15VUUM, 100 gal. double arm Mixer, 100 HP motor; 6-day 250 and 100 gal. double arm Mixers; 1-Ball & Jewell #1 Rotary Cutter; 2-Two Roll Mills 6"x12"; 6-Stokes Model DD2, DS3, D3 and B2 Rotary Preform Presses; 4-Stokes Model "R" single punch Preform presses; 1-Kux Model 15-25 Rotary Preform Press; Also: Sifters, Banbury Mixers, Powder Mixers, etc., partial listing; write for details; we purchase your surplus equipment; Brill Equipment Co., 2407 Third Ave., New York 51, N.Y.

FOR SALE: 64 Oz. Injection Molder with Pre-Plasticizer mold size 32"x50" 750 Ton clamp. Lester 8 oz. Model 2 ½L (1949). De Mattia 12 oz. (1946). De Mattia 4 oz. H.P.M. Rubber Injection molders, 21½" x28" mold space, steam heated platens. Watson Stillman 300 Ton Semi-Automatic Compression molding Press (1947) self-contained, mold size 34"x27". Watson Stillman 250 Ton 28"x24". Watson Stillman 140 Ton 22"x16". Waterbury Farrel 85 Ton 20"x24". W.F. 63 Ton 15"x15". Laboratory Presses—Elmes 20 Ton 8"x8", others 15 Ton 10"x8" and 10 Ton 6"x6" Platens. Scrap Cutters, Valves, Accumulators, Hydraulic Presses—all sizes. Aaron Machinery Co. Inc., 45 Crosby St., New York, N.Y. Tel.: WAlker 5-8300.

FOR SALE: 1—M P M 2½" electric extruder; 1—350 ton semi-automatic molding press, 18" ram, self-contained; 1—Stokes 200 ton semi-automatic compression molding press; 3—Cumberland #½ granulators, 3 HP; 1—Cumberland 14" rotary chopper; also mixers, mills, grinders, etc. Chemical & Process Machinery Corp., 52 Ninth St., Brooklyn 15, N.Y.

PAPER CAN & TUBE MACHINERY: For sale or lease—Spiral winders; convolute body makers; glue & tar pots; premelding pots; paper stands; OBI Bliss presses; strip feed presses; crimping & seaming machy; tube recutters; paper & metal slitters; labelling machines; metal end dies for round & irregular sizes; spiral & convolute mandrels. M. C. Ricciardi Co., Park Avenue, Alpha, N. J. —We buy plants & surplusage.

FOR SALE: Kaumagraph marking machine for plastic tubing 5/16" to 6" dia.—Less than 100 hrs. of use—$2,500.00. Reply Box 2929, Modern Plastics.

FOR SALE: 30 H.P. Explosion Proof tilting high shear mixer. Speed can be adjusted from 900 to 7200 R.P.M. 60 cycle 220-440 with extra blades & equipment ideal for plastisols, plastigels or very viscous solutions. Also used 3 Rolls 16x40 paint mill, water cooled. Will sell or trade for rubber mill in working order. Samuel Smidt Chemical Co., 410 Frelinghuysen Ave., Newark, N.J.

FOR SALE: Presses—1000 ton vertical—300-400 ton 36"x36" platens—500 ton R.D. Wood Downworking—4 oz. Injection Machine—No. 1 Ball-Jewell Grinder—Laboratory Presses to 75 ton—6"x13" Laboratory Mills—¾" Solenoid and Cam Operated Valves—Heating Kettles. Plastic Machinery Exchange, 426 Essex Ave., Boonton, N.J., telephone DE 4-1615, cable address Plasmex-Boonton.

STAINLESS STEEL KETTLE: Capacity available for volume Esterification, Sulfonation, Plasticizer, Resin Production. Reply Box 2905, Modern Plastics.

FOR SALE: 20 ounce Lester, New in 1952; 16 ounce H.P.M., New in 1953. Both machines fully equipped. Have been well maintained and are in excellent condition. May be seen in operation. Sterling Plastics Company, 1140 Commerce Avenue, Union, New Jersey.

AVAILABLE AT BARGAIN PRICES: 2—Pneumatic Scale Co. Cartoning Units, consisting of Automatic Carton Feeders, Bottom Sealers and Top Sealers. 50 per minute. 4—Scandia Practically New Automatic Cellophane Wrapping Machines. 1—Hayssen Model 10-20 Wrapping Machine, with electric eye. 4—Fitzpatrick Stainless Steel Comminuters with 7½ HP motors and with Vibrator Feeders. 1—Mikro Pulverizer with 40 HP motor and complete auxiliary equipment. 1—J. H. Day mixer with ribbon & wire Agitators and 5 HP motors, 500# cap. 2—J. H. Day Mixers with ribbon and wire Agitators and 20 HP motors measuring 96"x36"x40". Complete details and quotations promptly submitted. Union Standard Equipment Co., 318-322 Lafayette St., New York 12, N. Y.

SAVE CAPITAL INVESTMENT: on plastic equipment: Discover the FMC Rental-Purchase Plan; Baker Perkins Mixers from Lab. to 300 ga. in stock; Readco Vac. Mixer 750 Gal. W. & P. 1200 Gal. Vac. Mixer; NRM, Royle, Allen Extruders; Hydr. Presses to 2500 Ton; Stokes, Colton Tablet Presses; Blaw Knox Stainless Resin Kettle 2800 Gal. Dowtherm; Fitzpatrick Comminutaters Model K SS 20 HP; Model D-7½ HP. Send for Newest First Facts with complete inventory. First Machinery Corp., 209 Tenth St., Brooklyn 15, N.Y.

FOR SALE: 2 oz. Van Dorn, lever type, $1650; (3) 2 oz. aut. molding machines w/accumulator; 4 oz. Lewis, 1954, $3500; 4 oz. Acme, 1953, $5000; 4/6 oz. R-P, 1955; 4 oz. vert. DeMattia; 8 oz. R-P, 1948, $6500; 8 oz. R-P, 1946, $6000; 12 oz. W-S, Model E, $6500; 12 oz. DeMattia, toggle, $5000; 12/16 oz. DeMattia, Model M, $16,500; 12 oz. Lester w/solid frame, $5500; 16 oz. & 20 oz. vert. Impcos; 20 oz. R-P w/32 oz. cyl., almost new; 32 oz. R-P w/48 oz. cyl. exceptional; 48 oz. W-S, 1950; Model #246 Vactrim vacuum former; Preplasticizer for 16 oz. H.P.M., 48 oz. cap., almost new, for Model 350B; tumbling barrels, ovens, grinders, etc. Partial listing—other equipment available. Acme Machinery & Mfg. Co., Inc., 2315 Broadway, New York City, Su 7-1705.

FOR SALE: Stokes 300 ton and Baldwin-Southwark 200 ton semi-automatic Transfer Molding Presses. Thermal (La Rose) Preheaters. 2500 ton downstroke 54"x102". 800 ton Laminating Press 26"x38". 600 ton Baldwin 32"x36". 300 ton multi-opening 40"x40". Elmes 200 ton 28"x26". Farrel 200 ton 20"x80". 200 ton Hobbing Press. D&B 140 ton 36"x36". French Oil 120 ton self-contained. Also Lab Presses to 100 tons. Hydraulic Pumps and Accumulators. Van Dorn 1 and 2 ounce Injection Machines. Other sizes to 80 oz. Baker-Perkins and Day jacketed Mixers. Plastic Cutters. Oxford 57" Slitter. Seco 6" x 13" and 8" x 16" Mills and Calenders. Oil and Elect. Plastic Extruders, lab to 6". Single & Rotary Preform Presses ½" to 4". Partial listing. We buy your surplus machinery. Stein Equipment Co., 107—8th Street, Brooklyn, New York.

FOR SALE: Stokes DDS-2 Rotary Tablet Press 1" diameter punches and dies. Stokes Model R Tablet Press 1" diameter punch and die. 4—Hydraulic compression Molding Presses. Pull Back Cylinders, Knockouts, Individual Power Units. 1—75 Ton, 3—125 Ton. Triboro Electric Corp., 110 Waterbury St., Brooklyn 6, N.Y. HY 7-3535

FOR SALE: Injection Presses: Jackson-Church 64 oz., HPM 60 oz., 48, 20, 16, 9, 6 & 4 oz. Reeds: 8, 12, 16, 22 oz., Lester 8, 12, 20 oz., Watson 28, 12 & 6 oz., Lewis 4 oz., Moslo 2½ oz., Van Dorn 1 & 2 oz. Extruders: 4½" Hartig. 3½" oil heated NRM. 30" Sheet Die w. 52" Pull-Off. Dulmage Meterpump 28". Despatch PLHD 2-5 10 draw. Ovens. Despatch large Sheet Oven. Sterlco Circul.—Eclipse 6 HP Boiler. Apex 2 col. Container Imprint mach.—Compresssion Presses 50 to 600 T. Elmes Hydrolair press 30 T. Preformpresses Colton 5½ T. Stokes 280 G. Baker Perkins 200 Gal. Mixer. 42 cft Ribbon Mixer. Vac. Form mach. 30x30", 40x60". Dake 200 T. Trim Press. List your surplus equipment with me. Wanted: Stokes Standards 50 & 150 T. 1½ to 4½". Extruders. Defiance No. 20 Preformer. All Midwest locations. Justin Zenner, 823 Waveland Ave., Chicago 13, Ill.

Machinery and equipment wanted

WANTED: Used Blendor, Motor and Drive approx. 270 cub. ft. 36" Refiner, Motor and Drive, Granulator Ball & Jewel #2 Late Model, Pulverizer and Bale Pie Cutter. Reply Box 2918, Modern Plastics.

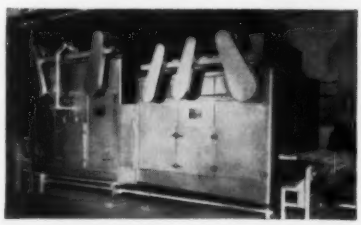
WANTED: One used 6"x12" laboratory mill or one used 8"x16" laboratory mill. Advise price, condition and model. Reply Box 2907, Modern Plastics.

(*Continued on page 290*)

Are You Wasting Heat Processing Dollars?

There's no doubt that gaining efficiency in plastic heat processing can be expensive if done on a hit-or-miss basis. The necessity for careful control of time, temperature and air velocity while maintaining production standards–can't be over-emphasized. Beyond that, the initial expenditure for a processing oven isn't written off over-night.

Michigan Oven Company has–for many years–been well-known for its engineering and craftsmanship in building ovens to fit the specific needs of manufacturer's in the plastic's industry.



Logically, you won't wish to miss any *sound* ideas on a better way to process your product. MOCO engineering has many of them. Wouldn't it be wise to investigate?

YOU'LL WANT THESE BASIC OVEN FACTS IF YOU DO ANY OF THESE OPERATIONS . . .

MOLDING • FABRICATING • EXTRUDING • COATING • LAMINATING • RECLAIMING • MATERIAL PRODUCTION • RE-INFORCEMENT

This Fact Book by MOCO engineers on the basic operating principles of heat processing ovens should prove interesting. If you have specific questions, please write.

PLASTICS DIVISION

MICHIGAN OVEN COMPANY

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IMS PURE

SILICONE FLUID MOLD RELEASE SPRAY

EXCLUSIVE, FAST, ALL-METAL VALVE ENDS FUMBLING SAVES CYCLE TIME

Keeps Mold Lube Cost Down

It Isn't Size — It's Performance and Quality That Count!

PRICES (Delivered)

Sample Can	$2.00
Per Unbroken Dozen	$18.00
Per Unbroken Gross	$197.40

The Economical Way to Buy and Apply Pure, Costly Silicone Fluid!

To Cover All Molding Conditions Keep Both Types on Hand

IMS PURE

ZINC STEARATE DRY POWDER SPRAY

HANDY MOLD DUSTER

Quick—Convenient

Removable, Cleanable Spray Head Directs Dust Into Cavity Without Waste.

PRICES (FOB Cleveland)

Sample Can	$2.00
Per Unbroken Dozen	$13.80
Per Unbroken Gross	$144.00

IMS Mold Releases are designed to bring you maximum quality and performance. Our Silicone Fluid Spray utilizes only more costly volatile Freon to minimize part marking on fast cycles. The Dry Powder Spray should be used in all applications where painting or plating follows the molding operation, also in preforming.

INJECTION MOLDERS SUPPLY CO.

3514 Lee Road • Cleveland 20, Ohio

(*Continued from page 288*)

PLASTICS MACHINERY

Cutters, Rotary, Plastic

Lab & Small Cutters, ⅓ HP to 5 HP
Ball & Jewell #1 with 10 HP MD
Ball & Jewell #2 Motor Driven, Extra Knives

Extruders

Hartig 3½" Elec Htd, 50" barrel, vari-speed drive.
Hartig 4½" Elec. Htd. 96" Barrel, 40 HP. U.S. Vari-Drive.
Stokes—Windsor Model RC-100 Twin Screw 10 HP Vari-Speed Drive

Injection Molding Machines

2 Oz. Van Dorn, Oversize Cylinder, Model H-200
2½ Oz. Van Dorn, Semi Automatic Nylon Cylinder
8 Oz. Reed-Prentice, 20 HP Motor Drive
12 Oz. HPM Model H-300-12
16 Oz. Reed-Prentice No. 10-E-16, Elec. Htd., 1948

Mills, Rubber/Plastic

18" x 50" Farrel, Rubber/Plastic, 75 HP MD
20 x 22 x 60 Adamson 125 HP Motor & reducer, floor level

Presses, Molding

15 Ton Baker Fully Automatic
15 Ton Stokes No. 200 D-2 Automatic (10)
30 Ton Baker Full Automatic Model 958, Excellent Condition, New 1951
40 Ton Francis, 4 Opening, 12" x 12" Elec. Heated Platens
50 Ton Stokes, Semi-Auto., Self Cont.
60 Ton Baldwin-Southwark, 7" Ram x 18" Stroke, 26" x 26" Platen
75 Ton Watson-Stillman Fully Automatic, 20" x 20" Platen 5 HP MD
75 Ton French Oil Mill 8" ram x 8" Stroke, 18" R-L x 17" F-B. Both up and down moving.
95 Ton French Oil Mill, 9" Ram x 12" Stroke, 29" R-L x 18" F-B, 3" Pull Backs
100 Ton Stokes Standard Semi-Automatic, Power System, Timing Controls
100 Ton Lake Erie Hi-Speed, 24" x 24" Bed, 12" DLO, Self Cont.
113 Ton French Oil Mill, 6 Opening, Elec. Htd., Platens 15" x 18"
113 Ton R.D. Wood, 5-Opening Elec. Htd. Platens 14" x 20"
150 Ton Stokes Standard Semi-Automatic, Power System, Timing Controls
175 Ton Viceroy Slab-Side 24" x 24", Elec. Htd. Platen with Hand Pump
200 Ton Stokes Semi-Automatic, Power System, Timing Controls
225 Ton Farrel 14" Ram x 18" Stroke, L-R 26½" x F.B. 24½" 7½ HP MD
300 Ton Stokes Semi-Automatic, Power System, Timing Controls
300 Ton Dunning & Boschert 30" x 30" Platen
314 Ton Lake Erie 36" x 36" Semi-Automatic, Push Button Controls 10 HP Pump & Motor
625 Ton Farrel, Steam Platens 52" x 52", Pump, Mtr., Controls, Under Power

Furnaces and Ovens

Megatherm, 3/60/220, 3 KW, 2-3 lb. Phenolic Per Min. (8)
Despatch Mdl. P1hd-8 8 Drawers, 12 x 18 x 2½" (2)

Tablet Machines

Model "E" Stokes, Complete with MD
Model R Stokes, Single Punch, Variable Speed Motor Drive, 3 HP
Model 45 Defiance, 200 Ton, 15 HP, Vari-Speed, MD
Model F, Stokes, Single Punch, MD
No. 5 Arthur Colton, Motor Drive, 3 HP
No. DDS-2 Stokes, 23 Stations, US Vari-Drive, 10 HP
Model T Stokes Hydraulic Equalizer, MD
Model 280-G Stokes Preform Press. 100 Ton Dual Pressure—Late

Mixers

Model "B" Banbury Lab type. Never used
No. 3A Banbury, 150 HP Md Rubber/Plastic
No. 3 Banbury 75 HP MD Excellent Condition Slide Door Construction

Calenders

6" x 16" Thropp, 3 Roll Chrome Plated, 7½ HP Vari-Speed
9" x 48" American Tool 4 Roll Doubling, Belt Drive
6" x 13" Elec. Htd. 6 Roll Lab Type, 7½ HP MD

Pelletizers

Mitts & Merrill Model 10-N-6 15 HP V.S. Drive

Make Us Your Prime Source for All Types of Plastics Machinery

Hydraulic Presses from lab size to 5,000 ton
Injection Molders from ¼ oz. to 60 oz. size
Extruders from lab size to 12"
Plastic & Rubber Mills and Calenders up to 84" size
Tablet Preform Presses, single punch and rotary, all sizes
Mixers all sizes, types and capacities

Also a complete selection of tumbling barrels, take-up equipment, hydraulic power units, pumps, ovens, blenders, scrap cutters, pelletizers, coating equipment and laminating equipment.

JOHNSON MACHINERY Co.

683-P Frelinghuysen Ave., Newark, N.J.

What Do You Need? What Have You To Sell?

Materials for sale

FILLER: Finely divided powder, asbestos & phenolic resin. 7,000# day continuous supply, very cheap. Will contract if desired. Samples available. Chemical Affiliates, Inc., 274 Madison Ave., New York 16, N.Y. MU 3-2593.

FOR SALE: 40,000 lbs. Reground opaque mixed colors Cellulose Acetate Butyrate. Guaranteed clean and free of contamination. Reply Box 2916, Modern Plastics.

COST CUTTING MATERIALS: Quality secondary materials available on continuous or spot basis. A perfect opportunity for manufacturers whose product pricing structure demands high quality materials for lowest possible prices. Write today for full particulars about our reground, reprocessed or surplus virgin, Polyethylene, Nylon, Styrene or Butyrate. Gem City Trading, P. O. Box 941, Dayton 1, Ohio.

Materials wanted

WANTED.
Plastics Scrap and Rejects of all kinds. Ground and unground. Also rejected molded pieces and surplus virgin molding powders. Top prices paid. Reply Box 2902, Modern Plastics.

SCRAP WANTED: Highest prices being paid for sheet scrap or surplus pellets. Only interested in Royalite, Cycolac, or Krolastic. Will accept mixed colors at no price penalty. Reply Box 2922, Modern Plastics.

WANTED.
Vinyl, polyethylene and styrene scrap for our manufacture of molding and extrusion compounds. We can use rigid from vacuum forming, lumps, bleeder, slabs, trimmings, rejects—anything suitable for reprocessing. Send samples and details or telephone. Steady buyers since 1940. Rotex Rubber Company, Inc., 1-23 Jabez Street, Newark 5, N.J. MArket 4-4444.

PLASTIC SCRAP: Laminators—Fabricators—Vacuum Formers. Acrylic—Acetate—Rigid Vinyl Needed Urgently—Best Prices Paid. Claude P. Bamberger, Inc., One Mount Vernon Street, Ridgefield Park, N.J. Telephone: HUbbard 9-5330.

Molds for sale

FOR SALE: Houseware molds, comb molds, also some novelty and specialty items. All in excellent condition. No reasonable offer refused. Send for list. Reply Box 2912, Modern Plastics.

FOR SALE: 4 Production Molds making 3 Boxes. 6 cavity 3 tops—3 bottoms $4\frac{3}{4}$x$4\frac{3}{4}$x13/16". 6 cavity 3 tops—3 bottoms 5" diameter x ⅞". 4 cavity 4 bottoms $5\frac{7}{8}$x4x1-11/16". 4 cavity 4 tops for above. All hardened steel—practically new—cost $17,000—replacement value $22,000—for quick sale $5500—Samples available. Reply Box 2913, Modern Plastics.

Molds wanted

WANTED: Injection molds—one item or complete line of proprietary consumer articles, also interested in molds for industrial parts such as knobs, handles, fasteners, boxes, etc. Will consider purchasing complete injection plant with end products or parts line. Designers: New items wanted—cash or royalty. Victory Mfg. Company, 1722 West Arcade Place, Chicago 12, Ill.—Estab. 1930.

WANTED: Molds (all kinds) for 2 oz. Van Dorn on royalty or other suitable basis mainly for Caribbean and Latin American market. Excellent references and trade connections. Reply Box 2923, Modern Plastics.

Help wanted

PLANT MANAGER WANTED: With practical or professional industrial and mechanical engineering background in a fast moving production organization. Essential to know and analyze costs and schedule orders. Experience in directing plant maintenance required. Injection molding, plastisol molding and plastisol chemistry helpful. Opportunity for stock ownership. Salary open. Location—New York metropolitan area. Send detailed resume in complete confidence—state number of factory and supervisory personnel you were/are responsible for. Reply Box 2930, Modern Plastics.

COMMERCIAL DEVELOPMENT SUPERVISOR: The position: To develop and lead market research, market development, technical service, and other commercial programs to establish new products in the insulating materials industry. You will supervise our technical service activities on new industrial laminates and other new products. Qualifications: A strong and varied technical background required in the electrical insulation field including some Commercial Development or sales experience. A combination of electrical, chemical and business experience or interests strongly desirable for this responsible position. Opportunities: Our planned growth programs and flexible salary structure provide unexcelled opportunities in the years ahead. Mr. Robert E. Dunham, Manager of Personnel Relations, The Richardson Company, 27th Avenue & Lake Street, Melrose Park, Illinois.

EXTRUSION FOREMAN: Opportunity with expanding custom profile extrusion company long established in Eastern U. S. Knowledge of die design, machine set up and the ability to train and handle people required. This is a permanent position and means working in a congenial atmosphere with a friendly and progressive smaller size company. Reply Box 2915, Modern Plastics.

TECHNICAL SERVICE: Laminates—Experienced man to assume technical sales service function on high pressure laminates for a leading laminator, fabricator and molder in the Chicago area. This responsible position in our newly formed Commercial Development group represents an excellent opportunity for the right man whose predecessor was recently promoted within our rapidly expanding organization. Please submit your resume to Mr. Robert E. Dunham, Manager of Personnel Relations, The Richardson Company, 27th Avenue & Lake Street, Melrose Park, Illinois.

WANTED: Plastics Engineer with experience in Injection molding, finishing, set-ups, mold design and tooling. Established firm located in central New York. Salary commensurate with experience and ability. Reply Box 2914, Modern Plastics.

(*Continued on page 292*)

Convert Your Plastic SCRAP Into Easy CASH

Gering consistently pays top prices for thermoplastic scrap . . . all types and forms . . . including rejects and obsolete molding powders.

- Polystyrene
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- Vinyl
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GERING PRODUCTS, INC., Kenilworth, N. J.

REDUCE KERF

by 20% or more with

thin rim

TUNGSTEN CARBIDE-TIPPED

KARBIDE KING

SAW BLADES

Made especially for cutting operations where thin kerf requirements will save you material and money! THIN RIM Blades are ideal for hand feed precision cutting and power feed with certain limitations.

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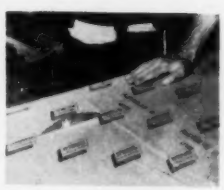

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(*Continued from page 290*)

CHEMICAL ENGINEER: Excellent opportunity in research for a chemical engineer with a creative flair. Should have 2-5 years plastics compounding and processing experience. Will work with research chemists and industrial designers to devise interesting new forms for plastics. Director of Personnel Research and Engineering Div. Monsanto Chemical Co. Box 8, Sta. B, Dayton 7, Ohio.

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SALESMAN: Exp. for plastics extrusions—all territories. Well established manufacturer of flexible and rigid plastic extrusions offers for 1st time excellent opportunity for experienced salesman or manufacturer's representative; we are equipped for volume & special development work; your have 100% factory support. Replies held in strictest confidence. Reply Box 2921, Modern Plastics.

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SALES ENGINEER: Outstanding opportunity with a well known, rapidly expanding national manufacturer. Prefer young engineering graduate with some experience in selling industrial materials or supplies. Knowledge of textile industry helpful. Submit personal resume. Reply Box 2909, Modern Plastics.

Situations wanted

PLANT MANAGER: Complete experience in continuous vacuum forming, equipment and mold design, injection molding and tool room. Desire to relocate in South. Reply Box 2931, Modern Plastics.

POSITION WANTED: At present technical director AaA-1 company division operating in non-ferrous foil rolling, extrusion, laminating, coating, vacuum metal evaporation. Metals, papers, boards, films, adhesives and colors. Electronics, containers and structural. Military and commercial. Technical and policy. Wish to change; available for one or two days per week on permanent basis. Reply Box 2903, Modern Plastics.

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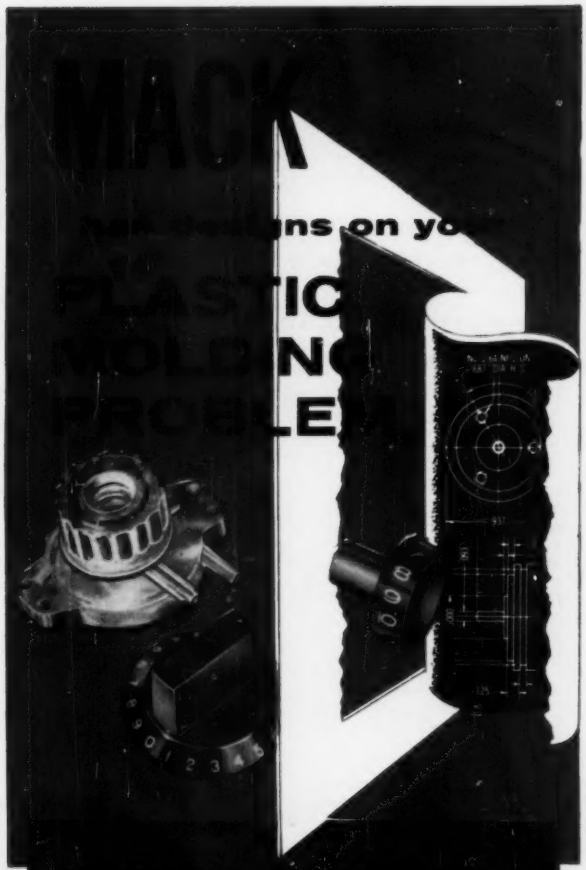

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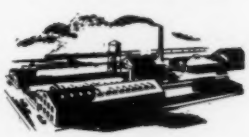

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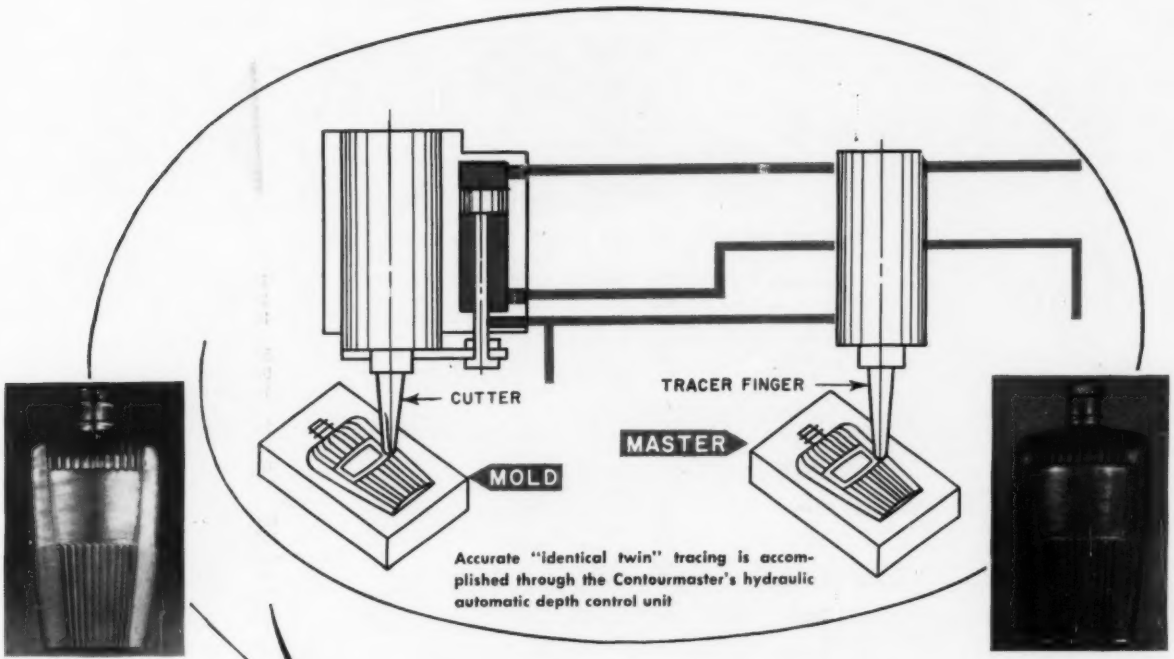

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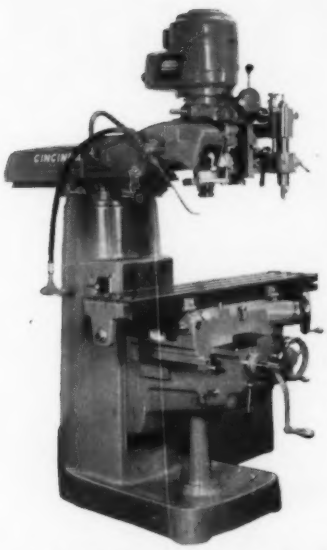

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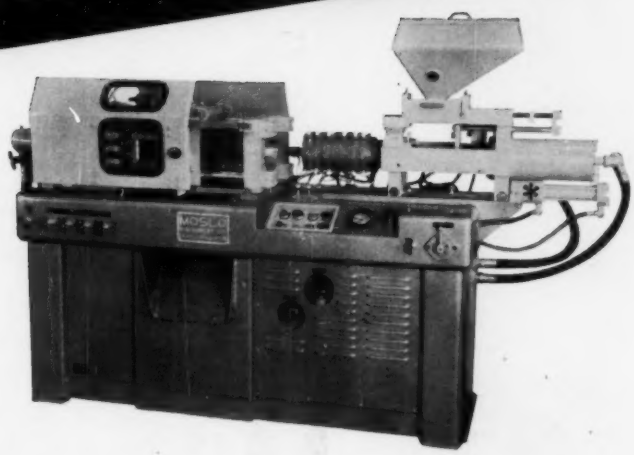

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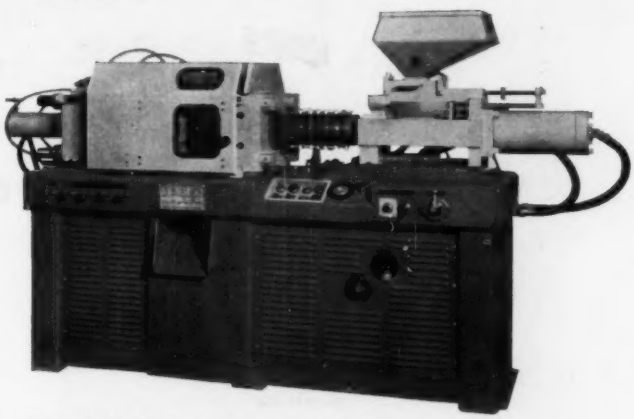

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DIAMOND PVC-45	0.38	Calendered Film and Sheeting Profile Extrusions Injection Moldings	Excellent dry blending, heat stability and clarity with low gel particle count Medium molecular weight offers easy processing
DIAMOND COMPOUND R-4		Type I Rigid PVC fittings, valves and pipe Calendered Rigid PVC Sheeting	Approved by National Sanitation Foundation Superior heat stability and easy processing characteristics permit use in conventional molding equipment Superior chemical resistance
Miscellaneous Plasticized DIAMOND PVC Compounds		For all types of extruded and molded products	Tailored compounds to meet customers' processing and end use requirements

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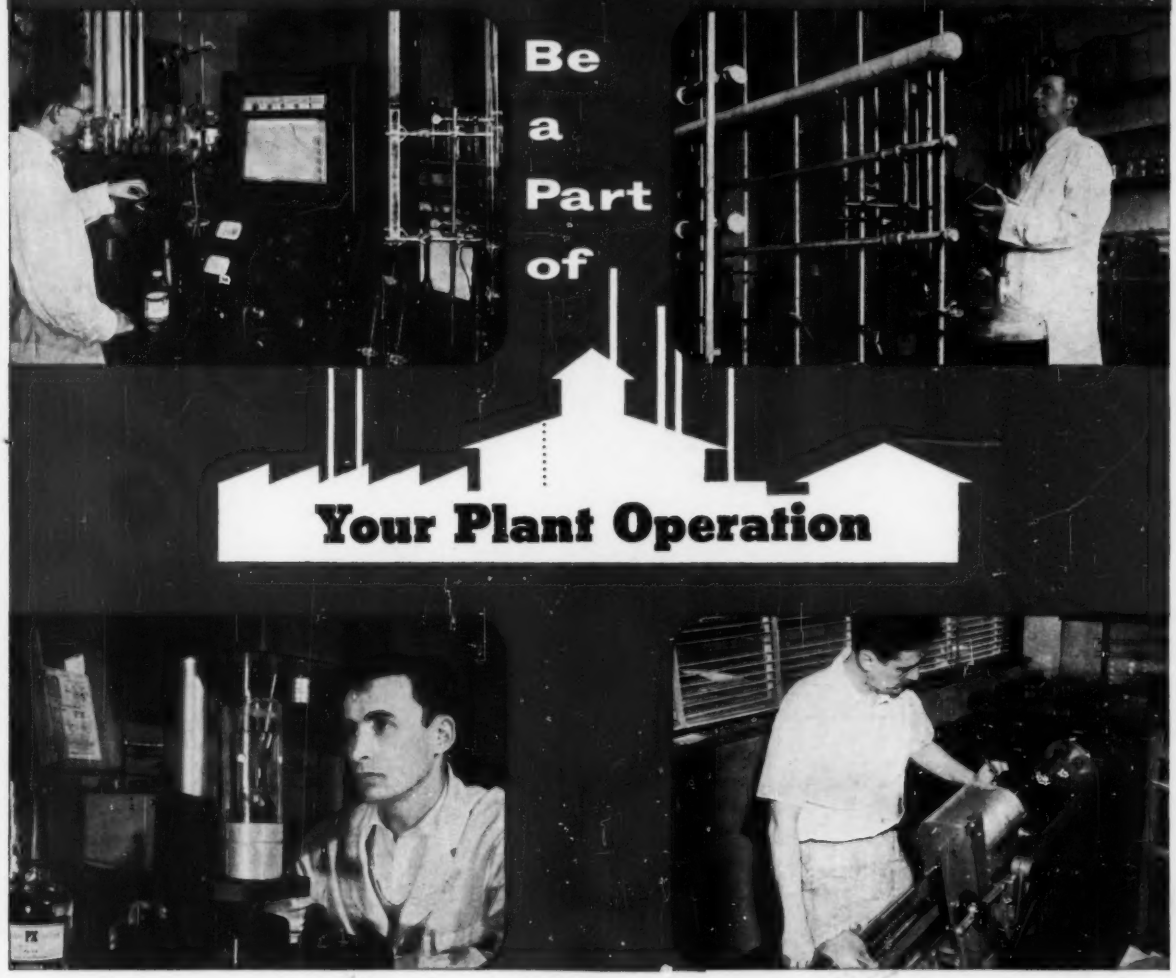
Diamond Chemicals

Let Pittsburgh Plasticizer Research



PITTSBURGH Coke & Chemical maintains a complete plasticizer research staff. Its objective: Provide the plastics industry with *better plasticizers* at *lower cost.*

You might consider this experienced group of chemists and engineers as part of *your* plant staff. For most of its efforts are devoted to solving basic problems and filling basic needs of Pittsburgh's customers . . . above and beyond our regular technical service. Two outstanding new plasticizers, PX-114 and PX-313, were developed by this group.

What's *your* future in plastics? If it's not being guided by a research laboratory of your own, why not enjoy the benefits of using Pittsburgh PX Plasticizers and of working with a company that thinks and acts in terms of *futures* . . . through *basic position* . . . through *constant growth* . . . through *vigorous, imaginative research.*

PITTSBURGH COKE & CHEMICAL CO.

WBW 6487

PITTSBURGH *Job-Rated* PLASTICIZERS

COAL CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON

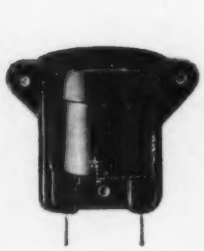
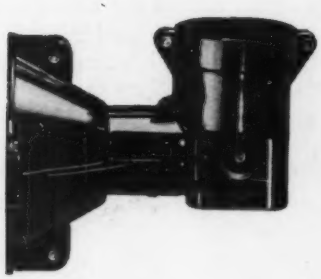
HERE'S WHAT A SINGLE G-E PHENOLIC DID FOR HAAS CORP.

Good machinability, fast cure, dimensional stability, high finish. The Haas Corp. of Mendon, Mich. molded these components from a single phenolic general purpose compound – G-E 12920. Each called for special properties... dimensional stability and machinability in the clothes dryer components, good finish in the socket housings, fast cure in all . . . typical of the combination of properties available only in phenolics, the value standard of the plastics industry.

Jim Buck, superintendent of molding operations at Haas, might have used a couple of molding powders to meet his requirements, but he chose G-E 12920. He says: "We found that G-E 12920 had the dimensional stability to lick warpage problems we've had with other materials. We like its molding properties, too: fast cure, more leeway on preheat, no hard spots. Because it works well on so many kinds of jobs, we don't have to stock many different compounds."

G-E 12920 (black) and *G-E 12921* (brown) general purpose molding powders may be the answer to many of *your* needs. For more information about them, write General Electric Company, Section MP-12, Chemical Materials Dept., Pittsfield, Mass.

Progress In Phenolics

GENERAL ELECTRIC

These parts called for a wide range of properties, yet all were molded from G-E 12920. From left: console base for automatic clothes dryer; sockets for incandescent and germicidal lamps in dryer; electrical socket housing for industrial use.